ThermaSource INC.
GEOTHERMAL CONSULTING SERVICES

November 25, 1994

Mr. Hank True
True Geothermal Energy Company
River Cross Road
Casper, WY 82602

Re: Condition of Well KA1-1, KMERZ

Dear Hank,

The enclosed report contains my opinion concerning the current structural integrity of Well KA1-1. I believe that the well is in good condition, is structurally intact, and is safe to operate. This opinion is based on analysis of a pressure-temperature-spinner (PTS) survey completed on October 29, 1994, and a caliper log of the 13-3/8" casing. The PTS log was run to a depth of 5763' where an obstruction, probably some fine formation material, was encountered. Throughout the logged interval from surface to 5763', there is no indication of any fluid movement in the wellbore and the temperature profile is not anomalous.

An internal caliper of the 13-3/8" casing was conducted on October 30, 1994. Because of the angle in the hole, the caliper arm could not extend out fully for a portion of the calipered interval. However the caliper did provide sufficient information to conclude that the 13-3/8" casing is not parted or structurally compromised at any point.

If you have any questions concerning this report, please call me at (707) 523-2960.

Yours truly,

Gerald Nimi
Vice-President

encl:

cc: Allan Kawada

725 Farmers Lane • P.O. Box 1236 • Santa Rosa, California 95402 • (707) 523-2960 • FAX (707) 523-1029

Condition of Well KA1-1

Purpose: The purpose of this report is to assess the condition of Well KA1-1, an exploratory geothermal well drilled in the Kilauea Middle East Rift Zone (KMERZ) on the Big Island.

Historical Perspective: Well KA1-1 was spudded in November 1989 by True/Mid-Pacific Geothermal Venture on lands leased from the Estate of James Campbell. The well is located in the Kilauea Middle East Rift Geothermal Sub-Zone (See Figure 1), at an elevation of 1504′ above sea level.

The original hole was drilled to a depth of 6944′ after setting and cementing 13-3/8" casing (68 ppf, 12.415" I.D., 12.259" Drift) from surface to 3370′ in two stages. On January 27, 1990, the open hole section of the well was abandoned with cement plugs and redrilled from the shoe of the 13-3/8" casing. Redrill #1 reached a total depth of 8741′ with a 9-5/8" casing liner set and cemented from 3153′ to 6572′, and the remainder of the well was drilled with an 8-1/2" bit and left uncased. Following a flow test, a decision was made to abandon this redrill with cement plugs, cut a window in the 13-3/8" casing, and redrill to a new bottomhole location.

On March 5, 1990, operations on Redrill #2 commenced. After resetting a 9-5/8" liner from 2895′ to 4550′, the well was

drilled with an 8-1/2" bit to 7824'. After testing was completed on April 25, 1990, operations were suspended until August 9, 1990. At that time, the well was abandoned with cement plugs and Redrill #3 was begun. A second window was cut in the 13-3/8" casing from 2764' to 2778' and the well redrilled. A 9-5/8" liner was set from 2485' to 5335' and an 8-1/2" open hole drilled to total depth of 7657'. Because of sloughing problems, the open hole section was plugged back with cement. Redrill #4 was started on October 1, 1990 from beneath the 9-5/8" casing. This redrill was drilled with an 8-1/2" bit to 7850'. A 7" slotted liner was set in the open hole section from 5115' to 7850'. The well was completed on October 10, 1990. This is the current configuration of the well. A sketch showing the original hole and the four redrills is shown on Figure 2. After testing the well, a pressure and temperature survey was conducted to 7500', and then operations were suspended on December 19, 1990. During the testing operations, the drill string with an 8-1/2" bit passed through the entire wellbore. At the time that the well was suspended, there were no indications of any structural problems with the well.

The primary reason for this conclusion is that the information from the pressure-temperature-spinner (PTS) survey shows no anomalous characteristics. The logging operation was stopped at 7500' because the hole temperature reached 660^{o} F, the tool limit. The fluid in the wellbore was still in a transition phase from steam to liquid. As such, pressures were less than

hydrostatic. Any substantial breach in the casing would have caused cool water to drain into the wellbore. No indication of this appears on the log as the spinner survey shows no movement beyond tool velocity. The cooling that is occurring is caused by the shallow ground water aquifer at 1000′ to 1700′. No temperature anomaly occurs in the 9-5/8" cased section from 2485′ to 5335′. As mentioned earlier, any collapse in the 13-3/8" casing would have prevented the drill bit from reaching bottom a few days before.

Subsequently another PTS survey was conducted on April 24, 1991. Again the 3" logging tool itself passed through the wellbore until encountering a bridge of soft material at 6350′. The pressure, temperature, and spinner survey showed no fluid movement in the wellbore. The static fluid level was located at 880′. Except for the ground water aquifer, there were no isothermal zones indicated. This leads to the conclusion that reservoir temperatures are not migrating up the hole.

Current Information: On October 29, 1994, another PTS survey was conducted. The 3" logging tool reached a depth of 5763′ before encountering an obstruction, reported by the logger to be something "soft" similar to that reported in April 1991. The spinner indicates static conditions in the wellbore. The pressure and temperature profiles show the ground water aquifer and little else. No high temperature isothermal zones were detected. Maximum temperature was 450°. The static water level

was detected at 950′ which is above the top of the ground water. Thus it can be concluded that the wellbore is not in communication with the ground water aquifer located between 1000′ and 1700′. Obviously if the two were in communication, the water levels would be identical. Furthermore, it would be likely that the ground water (being denser) would be migrating downhole and the cooling effect would be much larger. There is no evidence of that. Temperatures are cooler compared to the April 1991 survey, which could be attributed in part to poorer communication with reservoir fluids below.

On October 30, 1994, an attempt to caliper the upper 13-3/8" section of the well was attempted. An X-Y caliper failed to operate due to electronic problems. A backup single arm caliper was run into the hole to the approximate bottom of the 13-3/8" section at 2450′. In a vertical or nearly vertical hole, the caliper should provide an accurate measure of the internal diameter of the casing. The tool operated properly throughout, although at times the measurements were not representative because of improper tool orientation. Where the hole is near vertical, the measurements were representative of the casing size as from 1500′ to the surface, where the caliper shows the I.D. of the casing to be 12" to 12.4". This is right in line with 68 ppf, 13-3/8" casing which should range in I.D. from 12.259" to 12.415".

From 2425′ to 1500′, the tool was not oriented perpendicular to

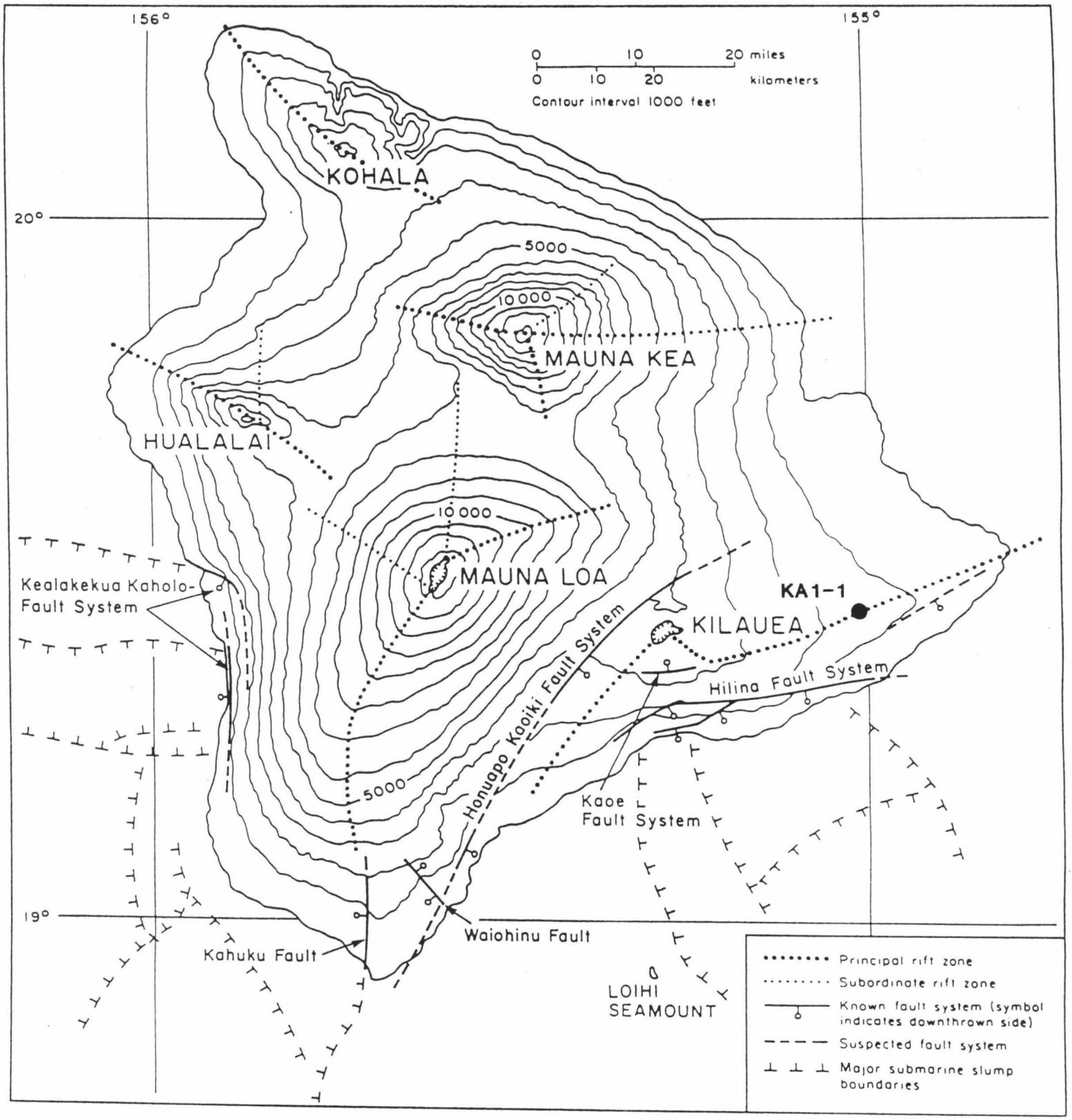
the casing axis, thus the measurements reflect only partial opening of the tool. The partial opening is caused when the tool is laying on the low side of the hole and the caliper arms do not have sufficient spring tension to force the proper orientation. (See Figure 3) Although the measurements are correct, they are not measuring the maximum I.D. Inspection of the log shows that the casing is open to least 9", and there is little risk in concluding that the casing is full gauge. It would be strange indeed for casing to collapse so uniformly, collars and all, for 765'. At 1650' the tool seemed to begin orienting toward a position perpendicular to the casing axis. This also correlates with the point when the hole angle decreased to less than 1 degree. (At 1750', the angle was 1^{o}; at 1620' it was $1/2^{o}$.)

As further proof that the caliper did in fact function accurately, the section from 425' to 460' shows an increase in diameter to 12-3/4". This correlates with the location 13-3/8" liner hanger which has an I.D. of 12-3/4". The caliper measurement at the surface indicates a reading of 6" which is the diameter of the lubricator, again verifying the fact that the caliper was providing accurate measurements.

As a final point, there has been no activity since 1990 that would cause casing that was in good condition to collapse. Both the PTS and Caliper logs are included with this report.

Summary and Conclusions: In summary, there have been three pressure-temperature-spinner surveys taken on KA1-1 since the well last discharged geothermal fluids in December 1990. (See Figures 4 & 5) Data from all three surveys indicate no fluid movement within the wellbore and no problems with structural integrity. Furthermore, a caliper shows the 13-3/8" casing to be full gauge from 1550′ to the surface. Minor, if any, scaling or corrosion is indicated. There is every reason to believe that the 13-3/8" casing is intact, i.e. not parted, along its entire length. If it were, the caliper would have detected it regardless of orientation. Tool orientation problems with the caliper precluded representative measurements from 1550′ to 2425′, however it is believed that the casing is full gauge. Although there is fill at the bottom of the well, the wellbore is still in communication with the geothermal reservoir as evidenced by the fact that the static fluid level has moved since 1991. From surface to 5763′, the well is structurally intact and safe to operate. It is probably in good condition below 5763′ all the way to total depth of 7850′, but this interval could not be surveyed.

November 25, 1994



Map showing volcanic rift zones and faults on the island of Hawaii. (Submarine slumps after Normark *et al.*, 1978.)

FIGURE 1

LOCATION OF KA1-1

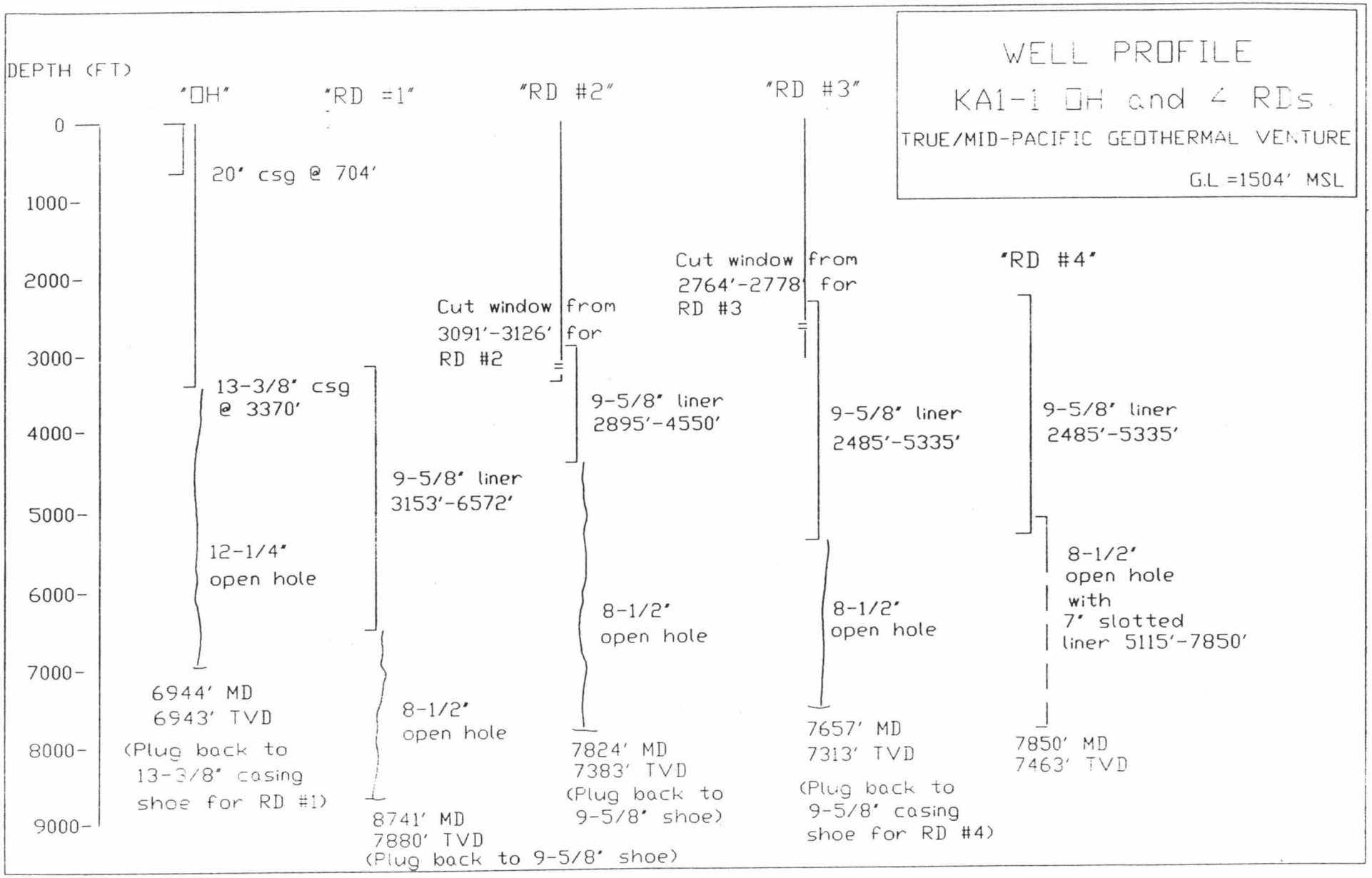
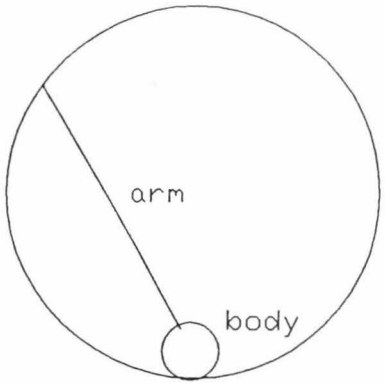

WELL PROFILE
KA1-1 OH and 4 RDs
TRUE/MID-PACIFIC GEOTHERMAL VENTURE
G.L =1504' MSL
DEPTH (FT)
0
1000-
2000-
3000-
4000-
5000-
6000-
7000-
8000-
9000-
"OH"
"RD =1"
"RD #2"
"RD #3"
"RD #4"
20" csg @ 704'
13-3/8" csg @ 3370'
12-1/4" open hole
6944' MD
6943' TVD
(Plug back to 13-3/8" casing shoe for RD #1)
Cut window from 3091'-3126' for RD #2
9-5/8" liner 3153'-6572'
8-1/2" open hole
8741' MD
7880' TVD
(Plug back to 9-5/8" shoe)
9-5/8" liner 2895'-4550'
8-1/2" open hole
7824' MD
7383' TVD
(Plug back to 9-5/8" shoe)
Cut window from 2764'-2778' for RD #3
9-5/8" liner 2485'-5335'
8-1/2" open hole
7657' MD
7313' TVD
(Plug back to 9-5/8" casing shoe for RD #4)
9-5/8" liner 2485'-5335'
8-1/2" open hole with 7" slotted liner 5115'-7850'
7850' MD
7463' TVD

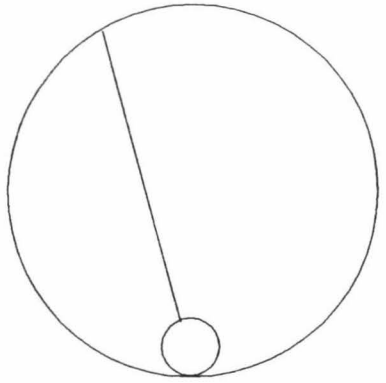
FIGURE 2

13-3/8", 68 ppf casing
Nom ID = 12.259" - 12.415"



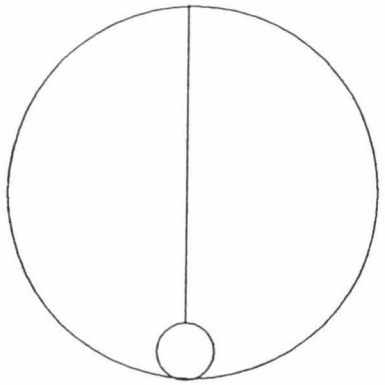
2425' - 1650'

Tool on low side
arm extension limited



1650' - 1550'

As angle decreases, tool
arm moves towards proper
position

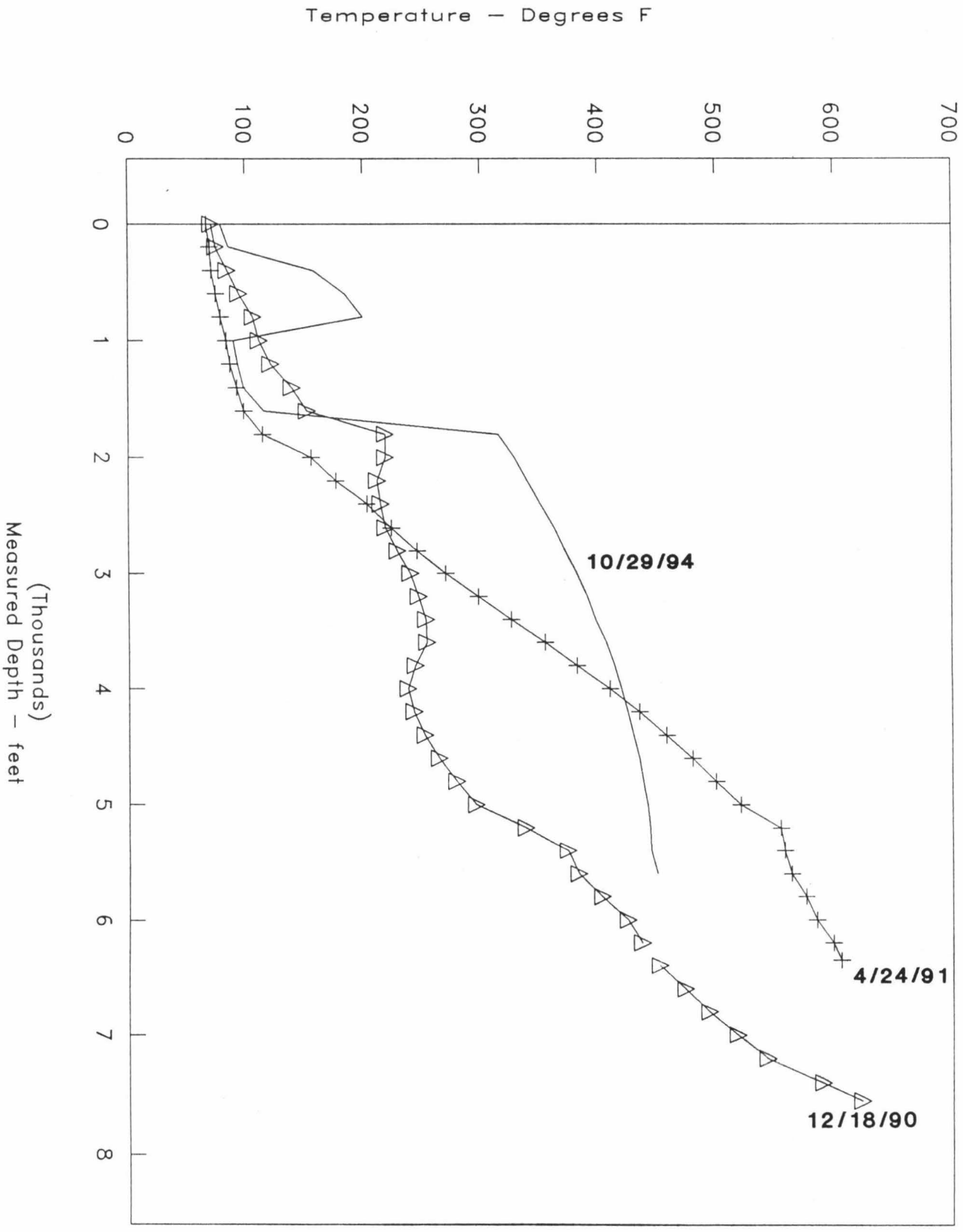


0 - 1550'

Correct Measurement

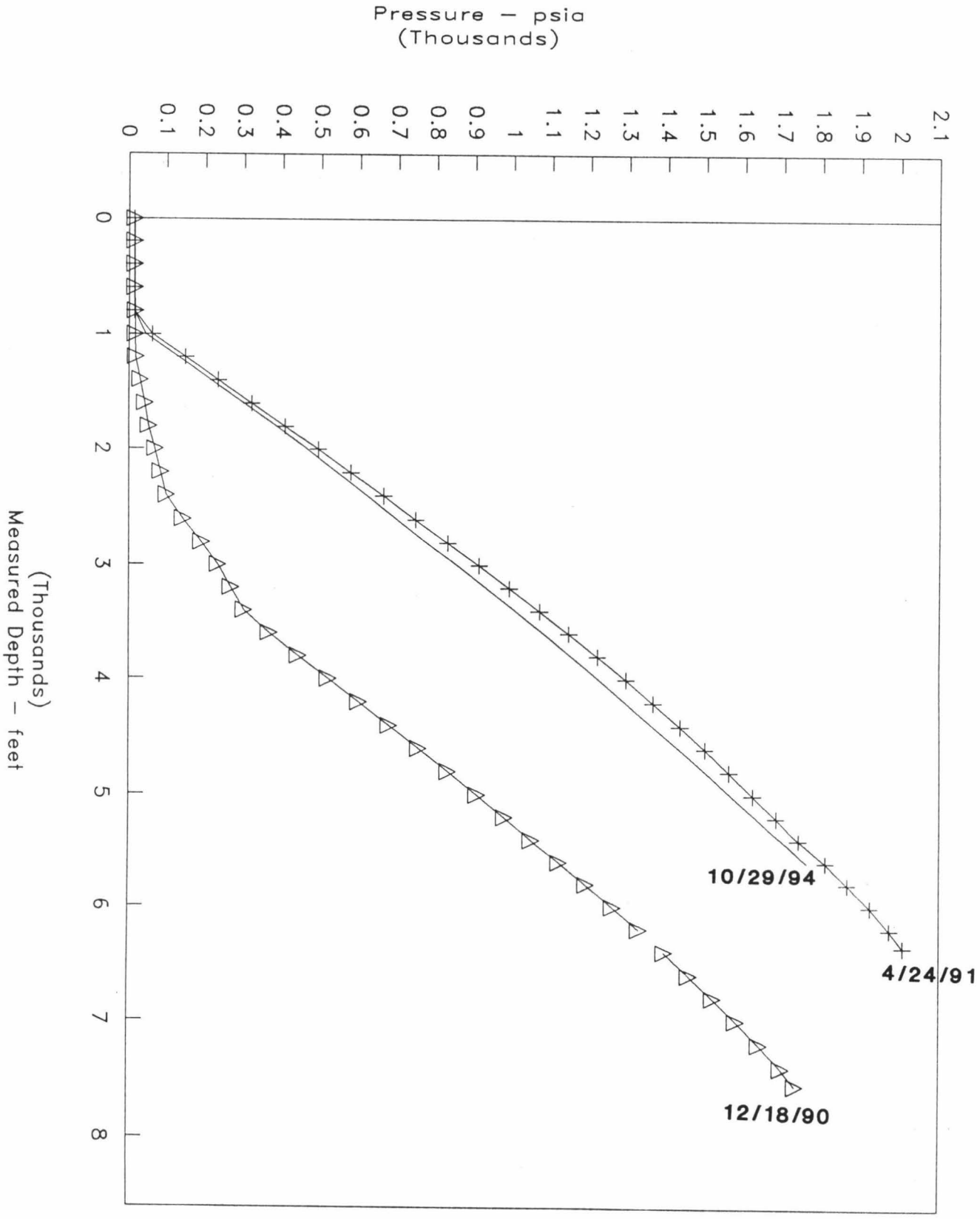
Performance of Caliper
KA1-1 Logging
10/30/94

FIGURE 3



TEMPERATURE PROFILES
KA1-1

FIGURE 4



PRESSURE PROFILE

KA1-1

FIGURE 5

LIST OF LOGS

1. PTS LOG, scale: 1"= 250', logging down

2. PTS LOG, scale: 1"= 50', logging down

3. PTS LOG, scale: 1"= 250', logging up

4. PTS LOG, scale: 1"= 50', logging up

5. Caliper, scale: 1"= 250', logging up

6. Caliper, scale: 1"= 50', logging up

HOT HOLE INSTRUMENTS INC.

Production Logs

COMPANY: True Geothermal Energy Co.
WELL: KA-1
FIELD: KMERZ
COUNTY: STATE: Hawaii

LOCATION: SEC. TWP. RGE.

PERMANENT DATUM: K.B. 27' ELEV.:
LOG MEASURED FROM: K.B DRILLING MEASURED FROM: K.B.

DATE:	10-29-94
RUN NO.	one
TYPE LOG	P.T.S.
DEPTH - DRILLER	7850'
DEPTH - LOGGER	5756'
BOTTOM LOGGED INTERVAL	5756'
TOP LOGGED INTERVAL	27'
TYPE FLUID IN HOLE	brine
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	953'
MAX. REC. PRESS.	1812 psia
MAX. REC. TEMP. F.	450
OPR. RIG TIME	
RECORDED BY	H.H.I.
WITNESSED BY	G. Niimi

ELEVATIONS

KB. 27'
DF.
GL.

UNIT #
TOOL #
LENGHT: 13.0'
DIA.: 3.0"

OTHER SERVICES:
Sinker Bar
Caliper

RUN	DATA FILE NAME
1	KA1.L1
2	KA1.D5
3	
4	
5	
L/H	

CASING RECORD

SIZE	WGT.	FROM	TO
13-3/8"		0	3370'
9-5/8"		2485'	5335'
7"		5115'	7850'

PERFS:	TYPE	FROM	TO
	slots	5115'	7850'

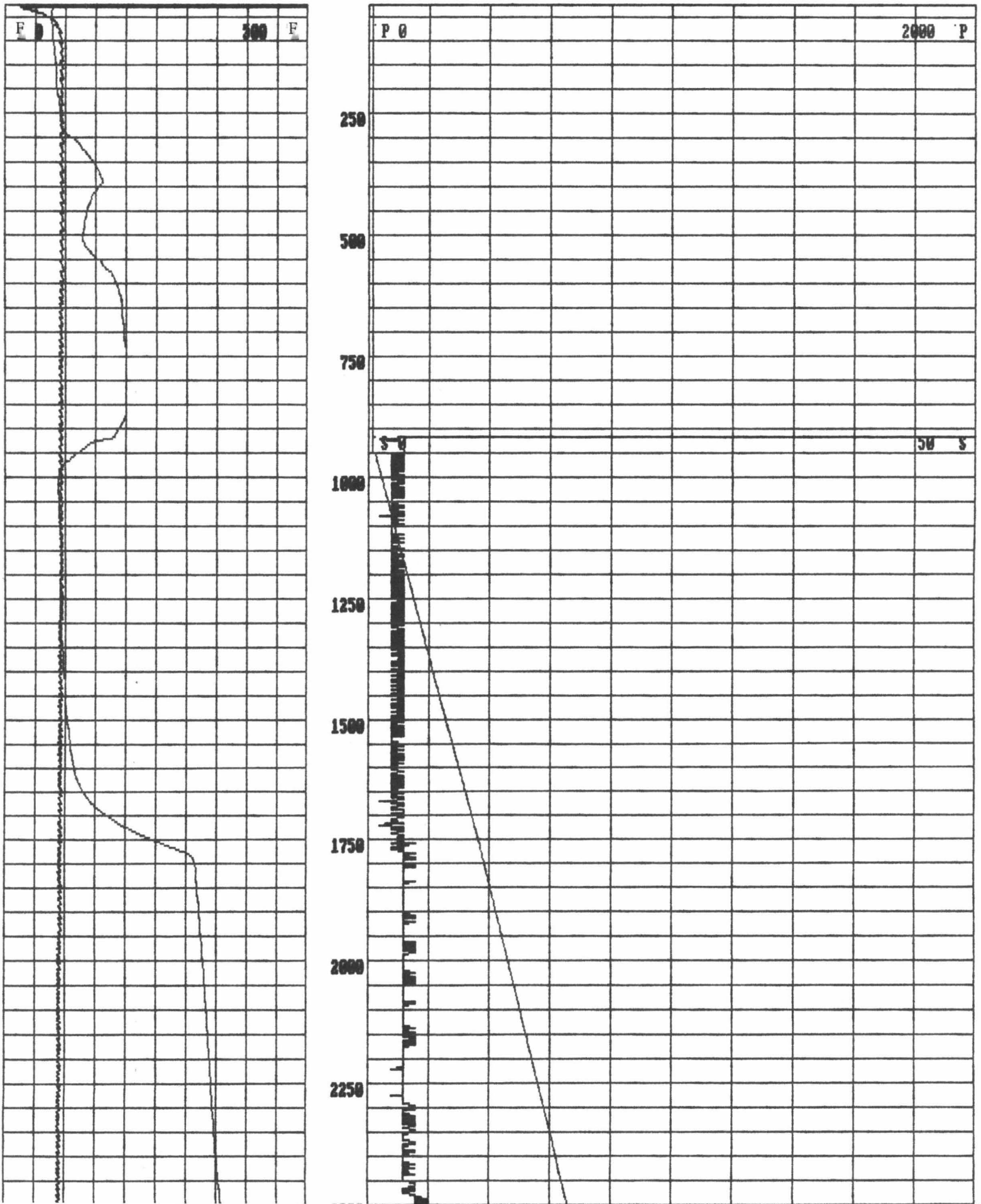
REMARKS:

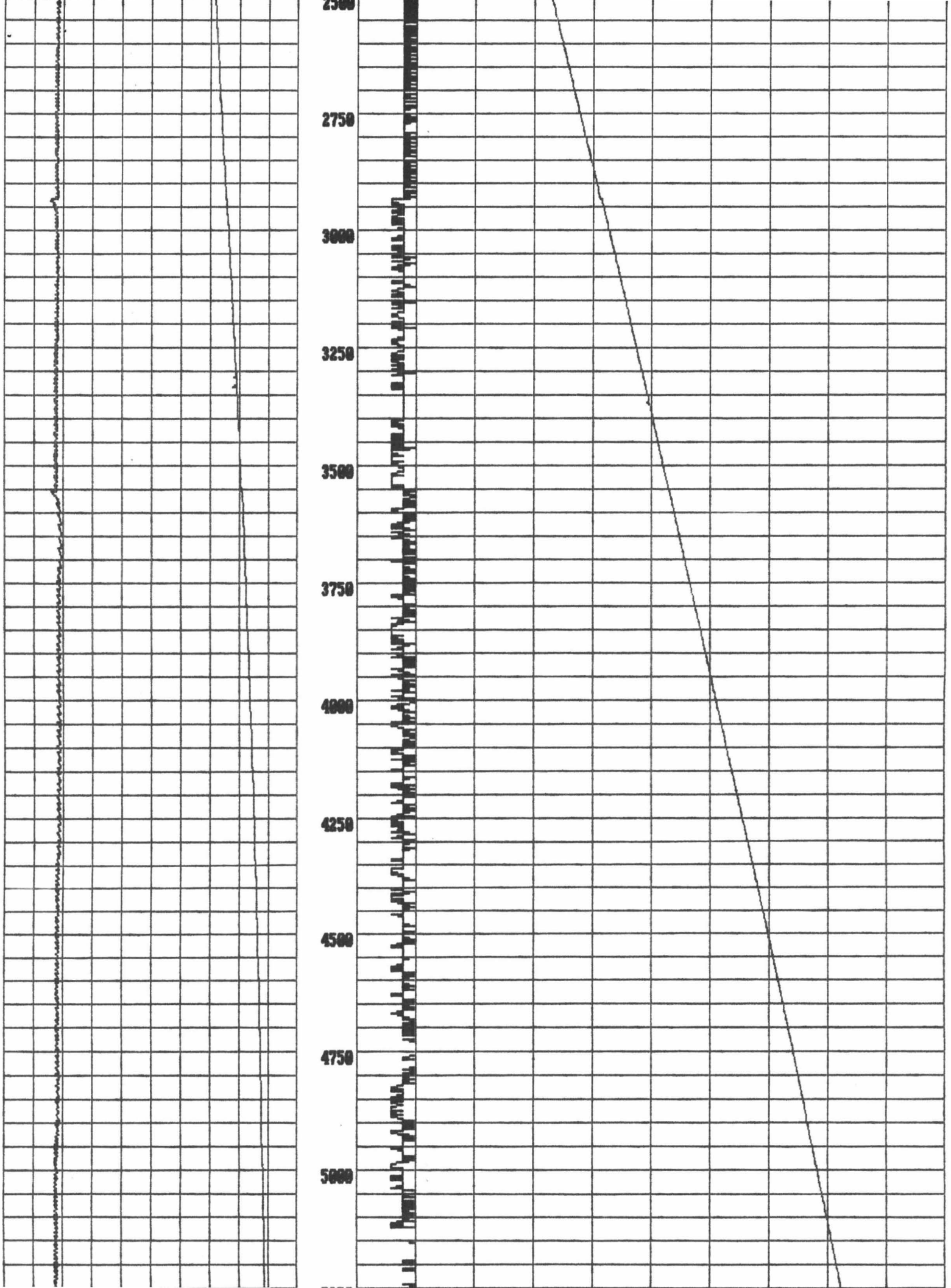
0°F TEMPERATURE 500°F

0-FPM LOGRATE 300-FPM

0-PSI PRESSURE RANGE 2,000 PSI

0-RPS SPINNER RANGE 50-RPS

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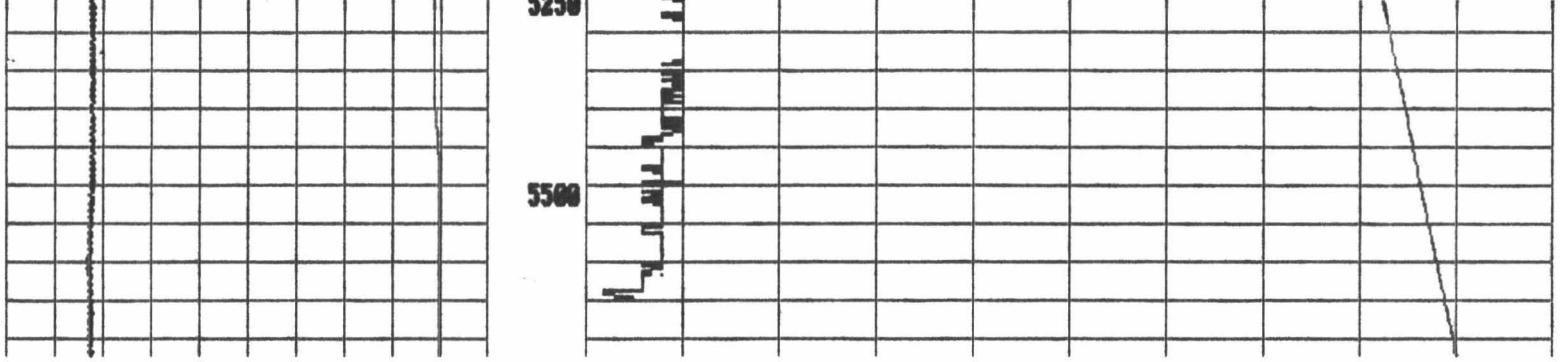

5250
5500

HOT HOLE INSTRUMENTS INC.

Production Logs

COMPANY: True Geothermal Energy Co.
WELL: KA-1
FIELD: KMERZ
COUNTY: STATE: Hawaii

LOCATION: SEC. TWP. RGE.

PERMANENT DATUM: K.B. 27' ELEV.:
LOG MEASURED FROM: K.B DRILLING MEASURED FROM: K.B.

DATE:	10-29-94
RUN NO.	one
TYPE LOG	P.T.S.
DEPTH - DRILLER	7850'
DEPTH - LOGGER	5756'
BOTTOM LOGGED INTERVAL	5756'
TOP LOGGED INTERVAL	27'
TYPE FLUID IN HOLE	brine
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	953'
MAX. REC. PRESS.	1812 psia
MAX. REC. TEMP. F.	450
OPR. RIG TIME	
RECORDED BY	H.H.I.
WITNESSED BY	G. Niimi

ELEVATIONS

KB. 27'
DF.
GL.

UNIT #
TOOL #
LENGHT: 13.0'
DIA.: 3.0"

OTHER SERVICES:
Sinker Bar
Caliper

RUN	DATA FILE NAME
1	KA1.L1
2	KA1.D5
3	
4	
5	
L/H	

CASING RECORD

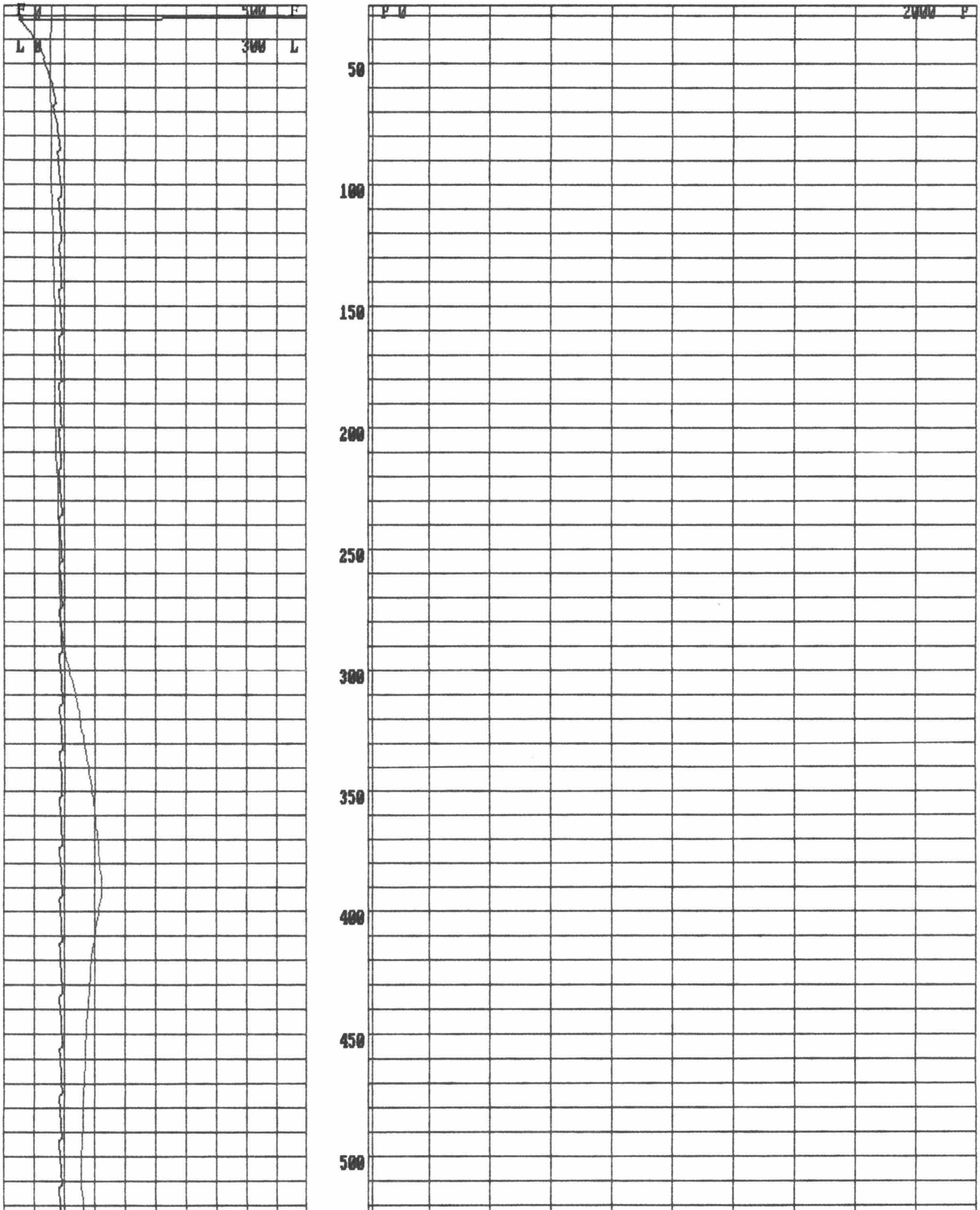
SIZE	WGT.	FROM	TO
13-3/8"		0	3370'
9-5/8"		2485'	5335'
7"		5115'	7850'

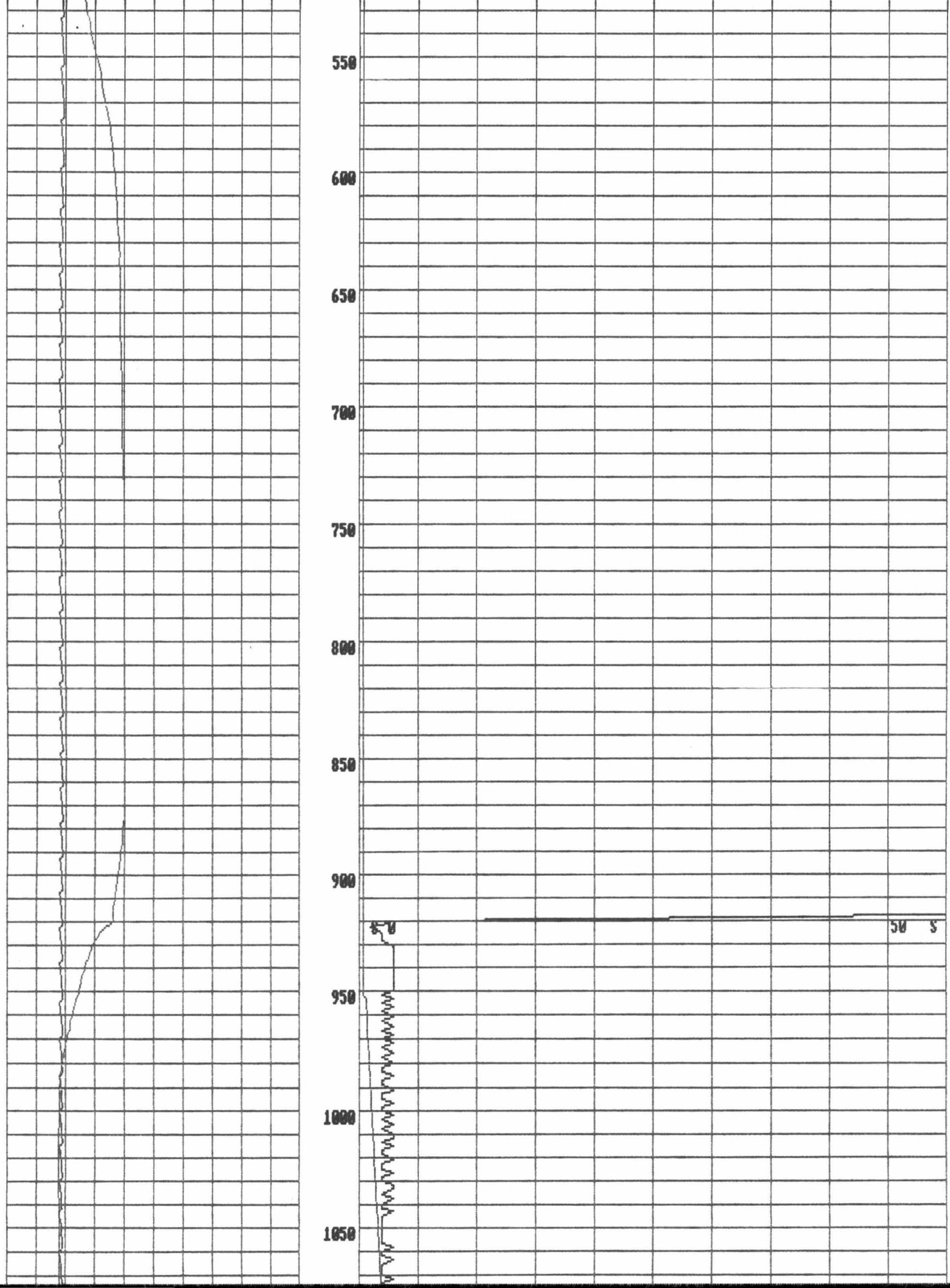
PERFS:	TYPE	FROM	TO
	slots	5115'	7850'

REMARKS:

0°F TEMPERATURE 500°F 0-PSI PRESSURE RANGE 2,000 PSI

0-FPM LOGRATE 300-FPM 0-RPS SPINNER RANGE 50-RPS

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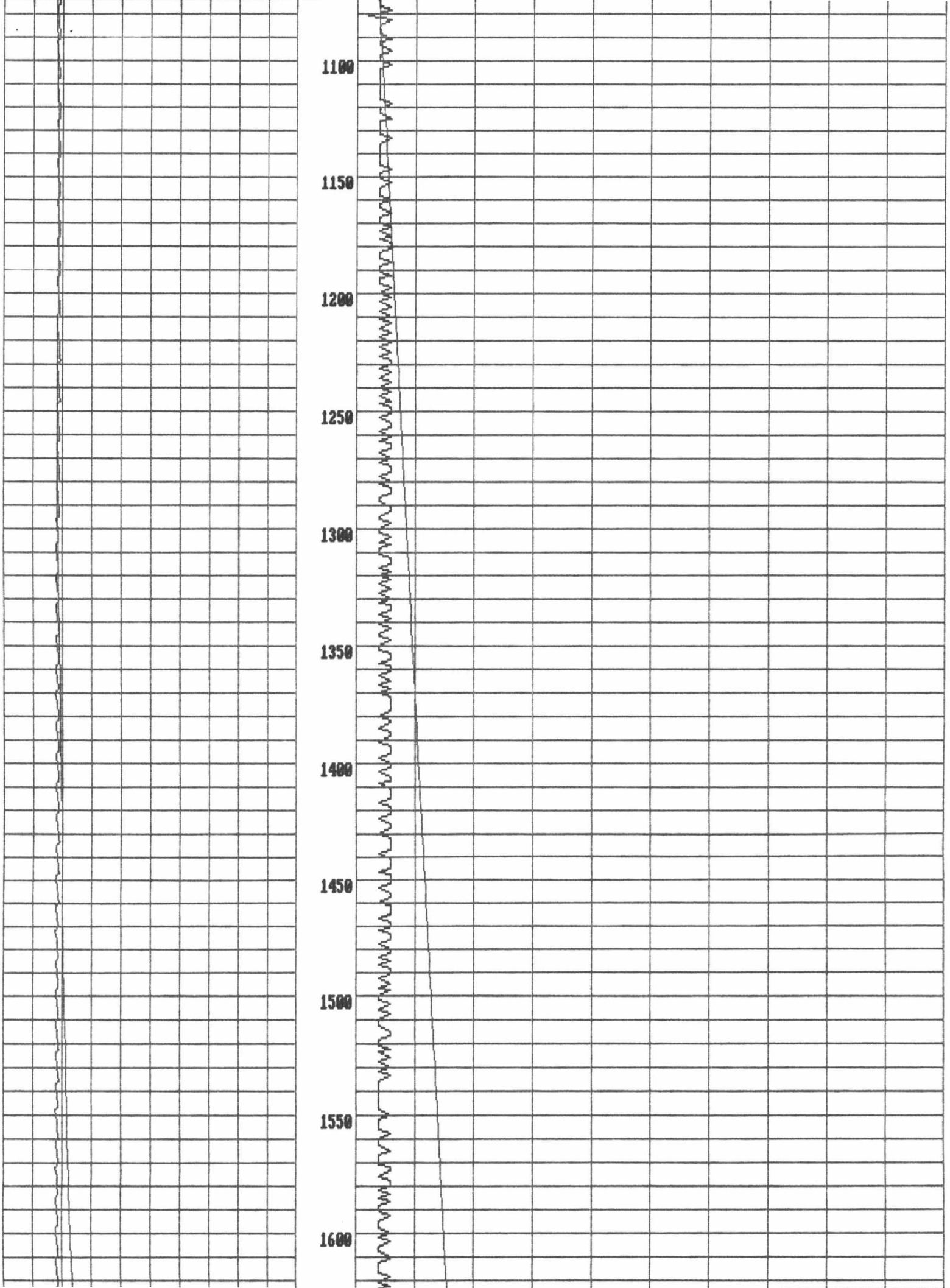
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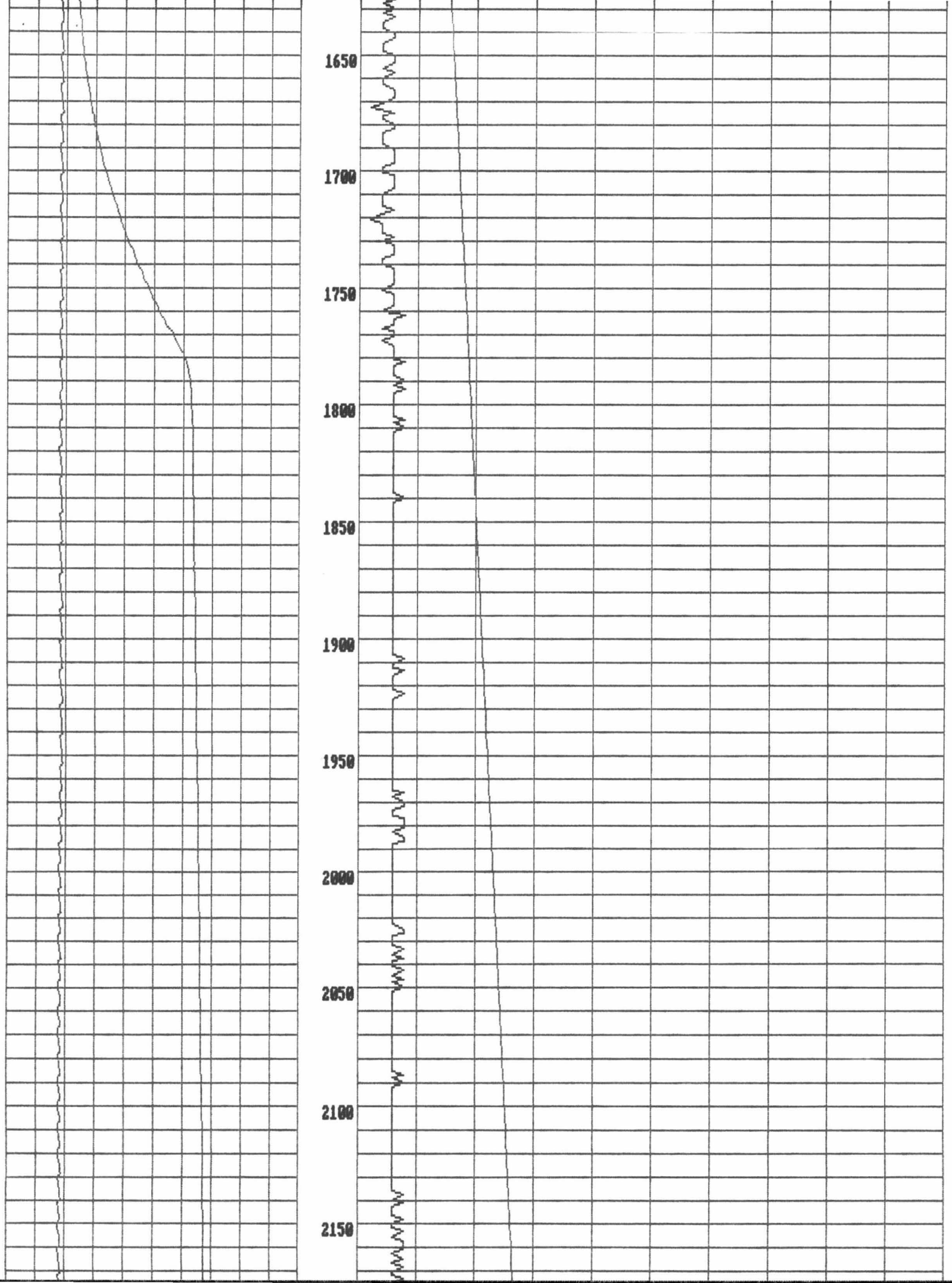
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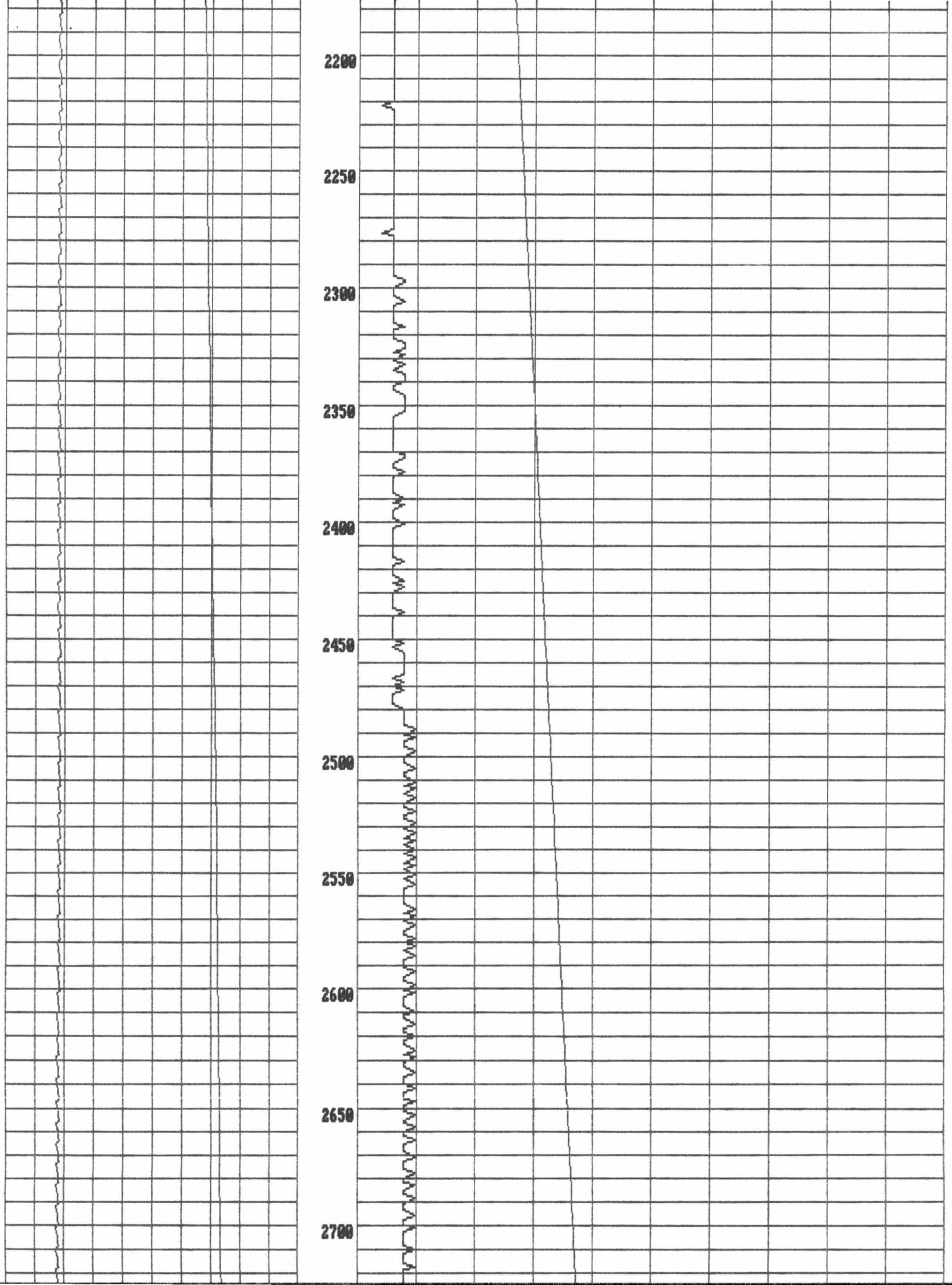
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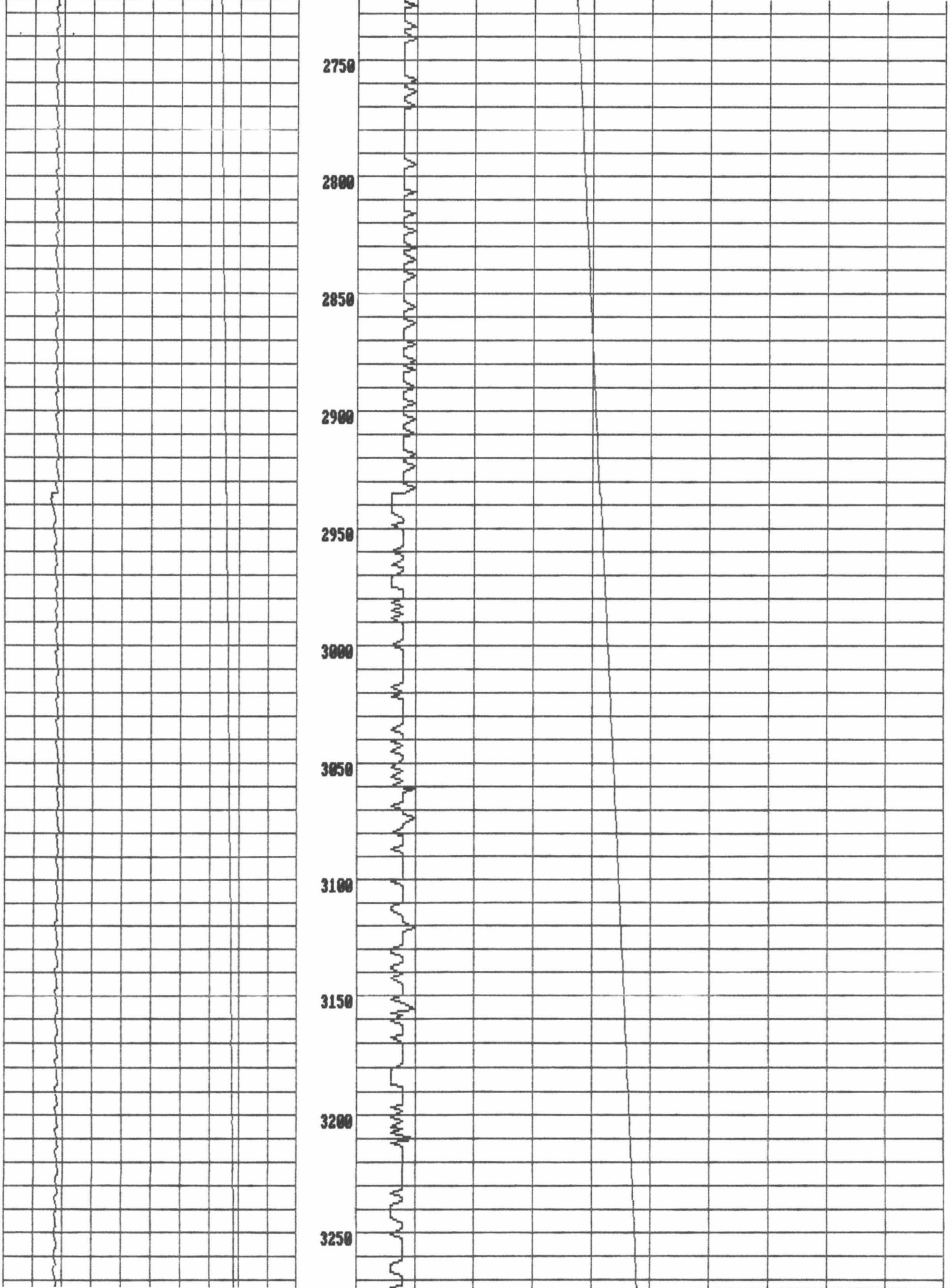
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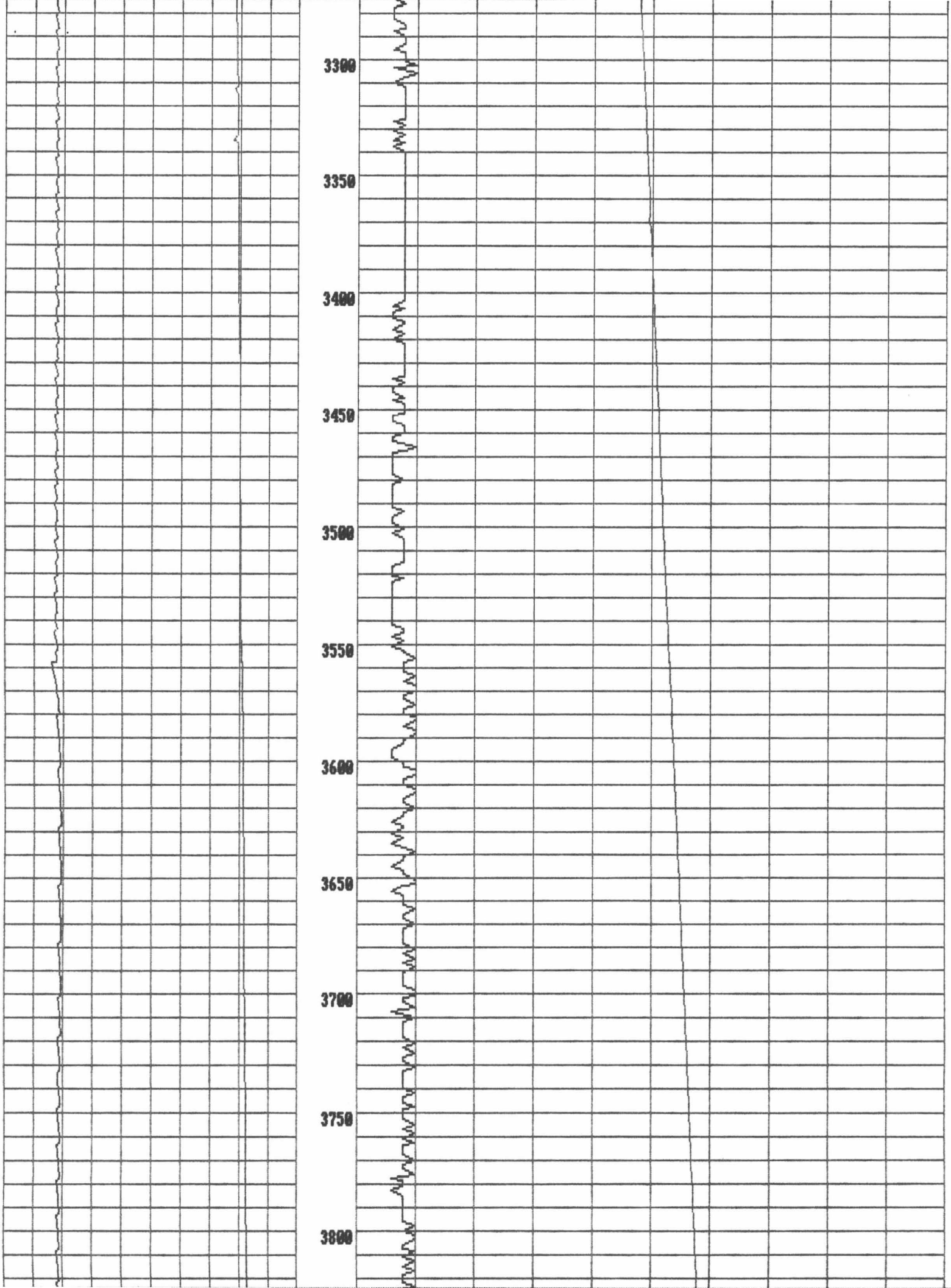
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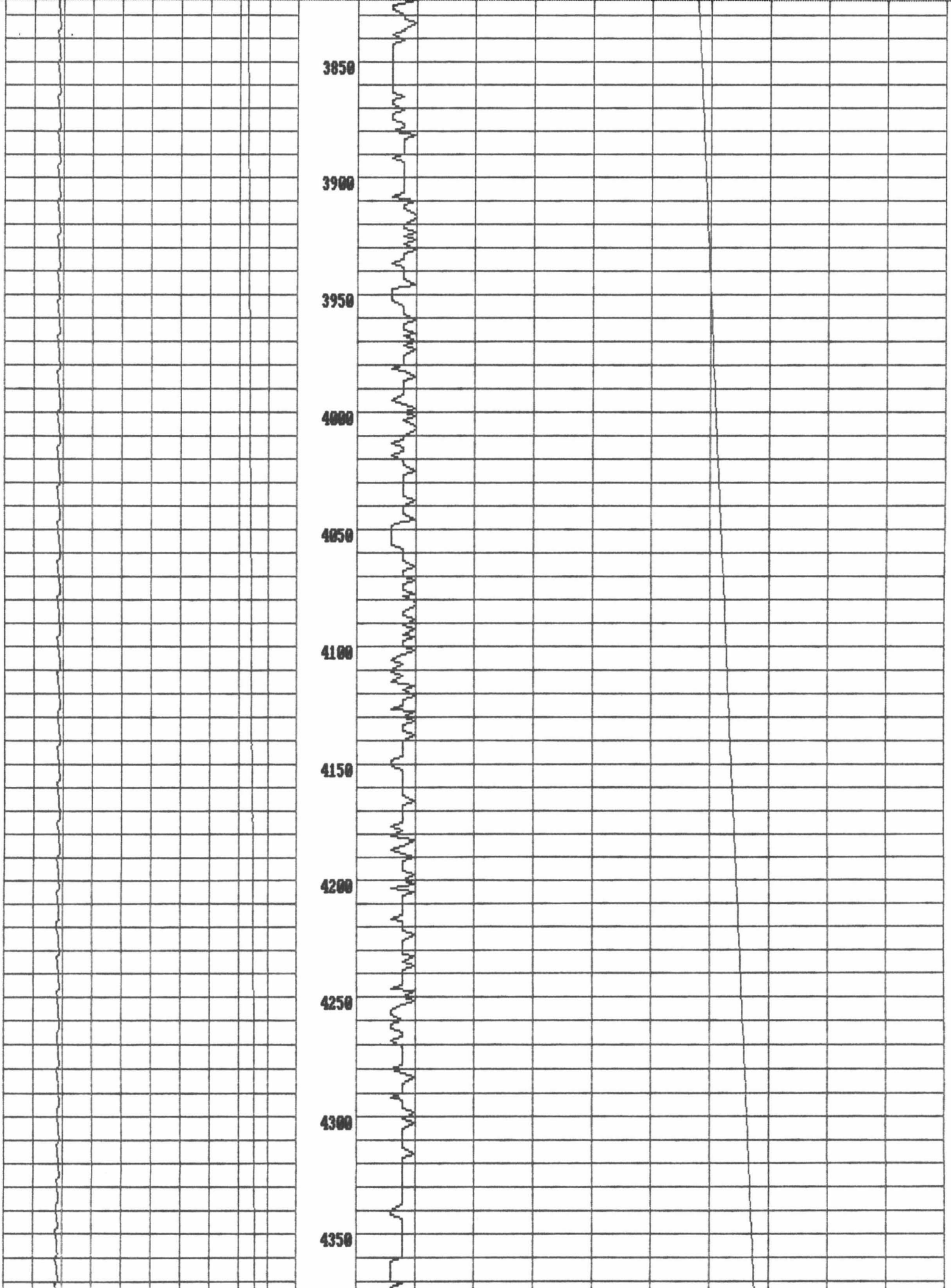
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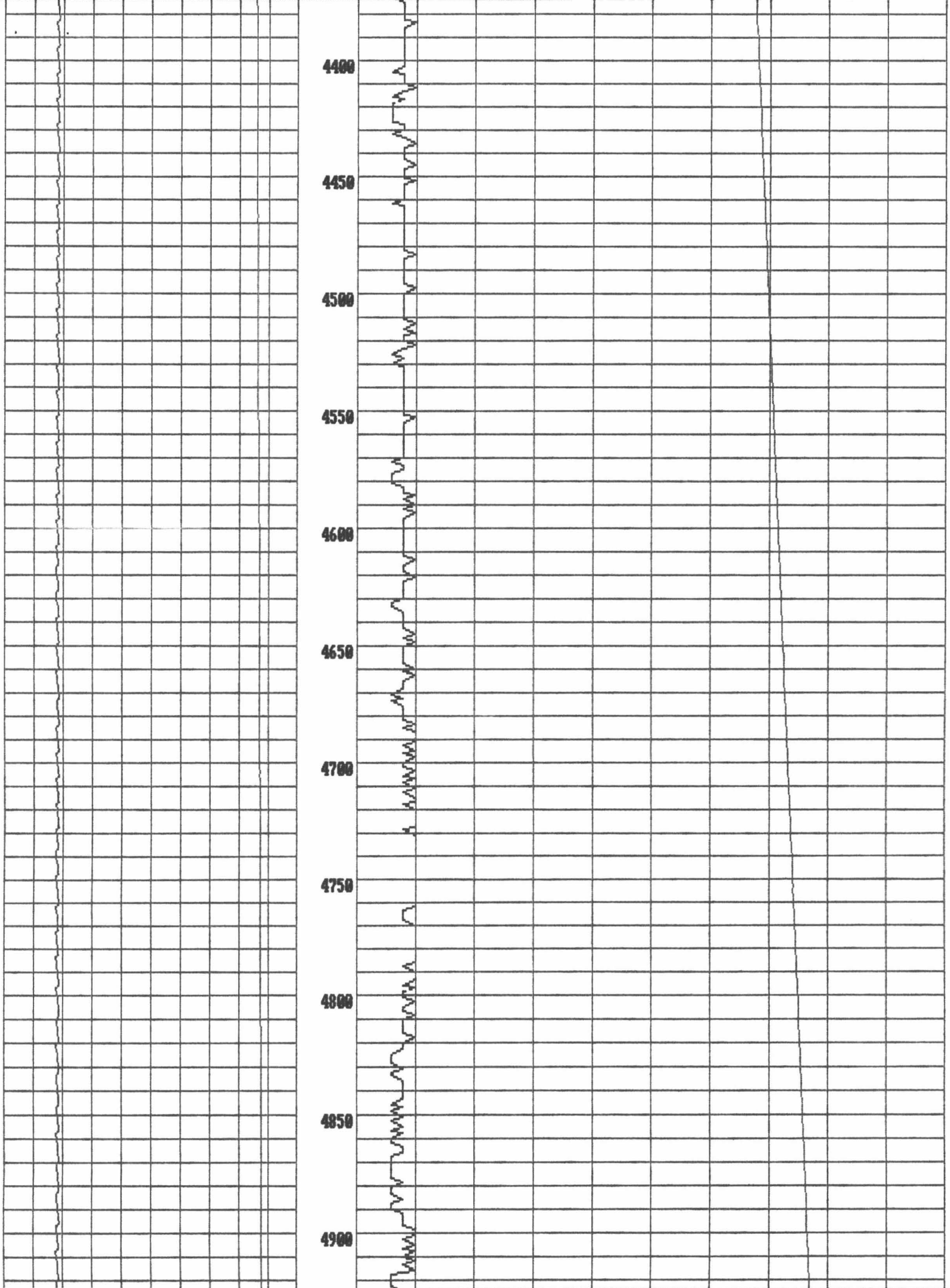
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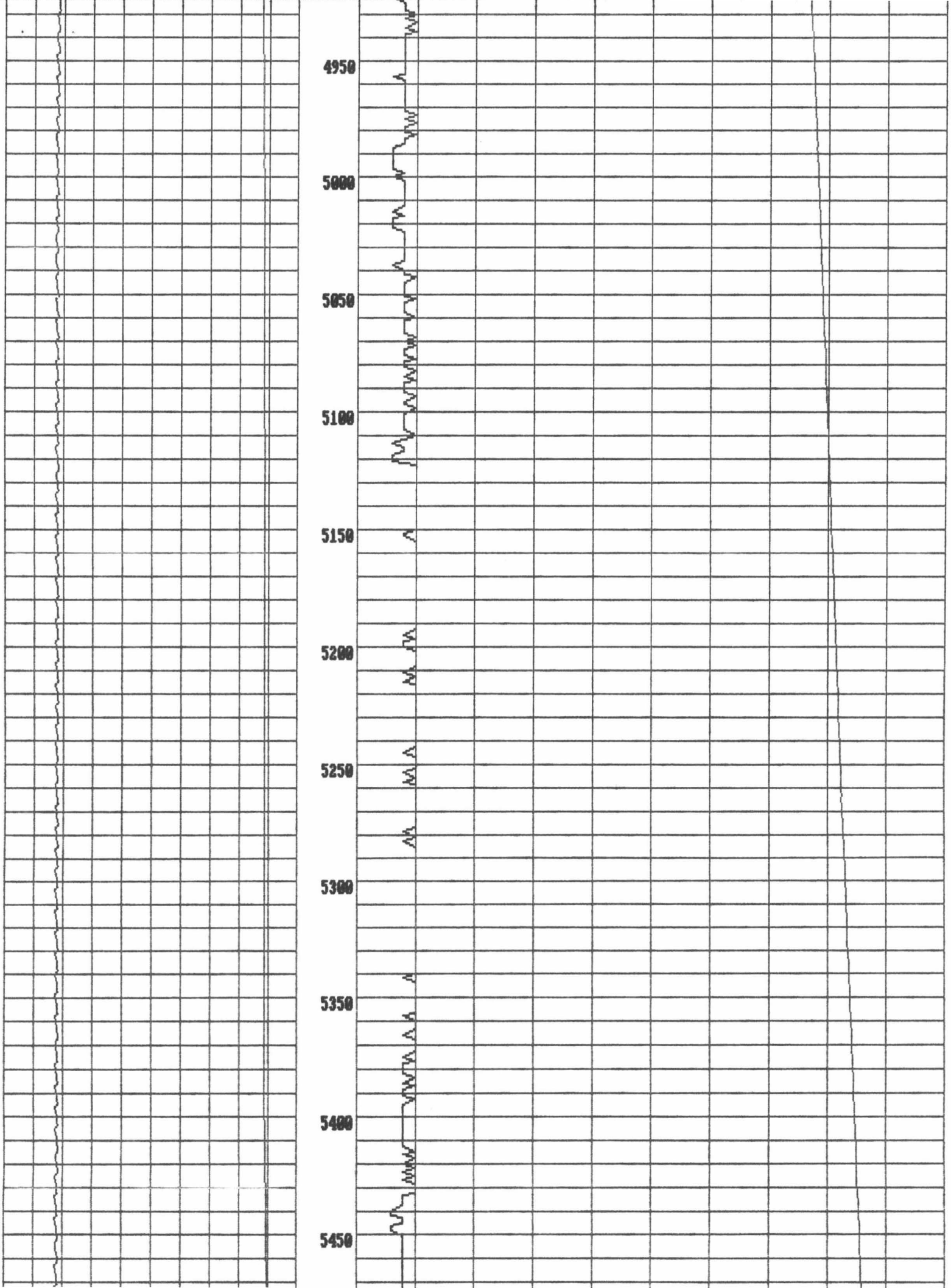
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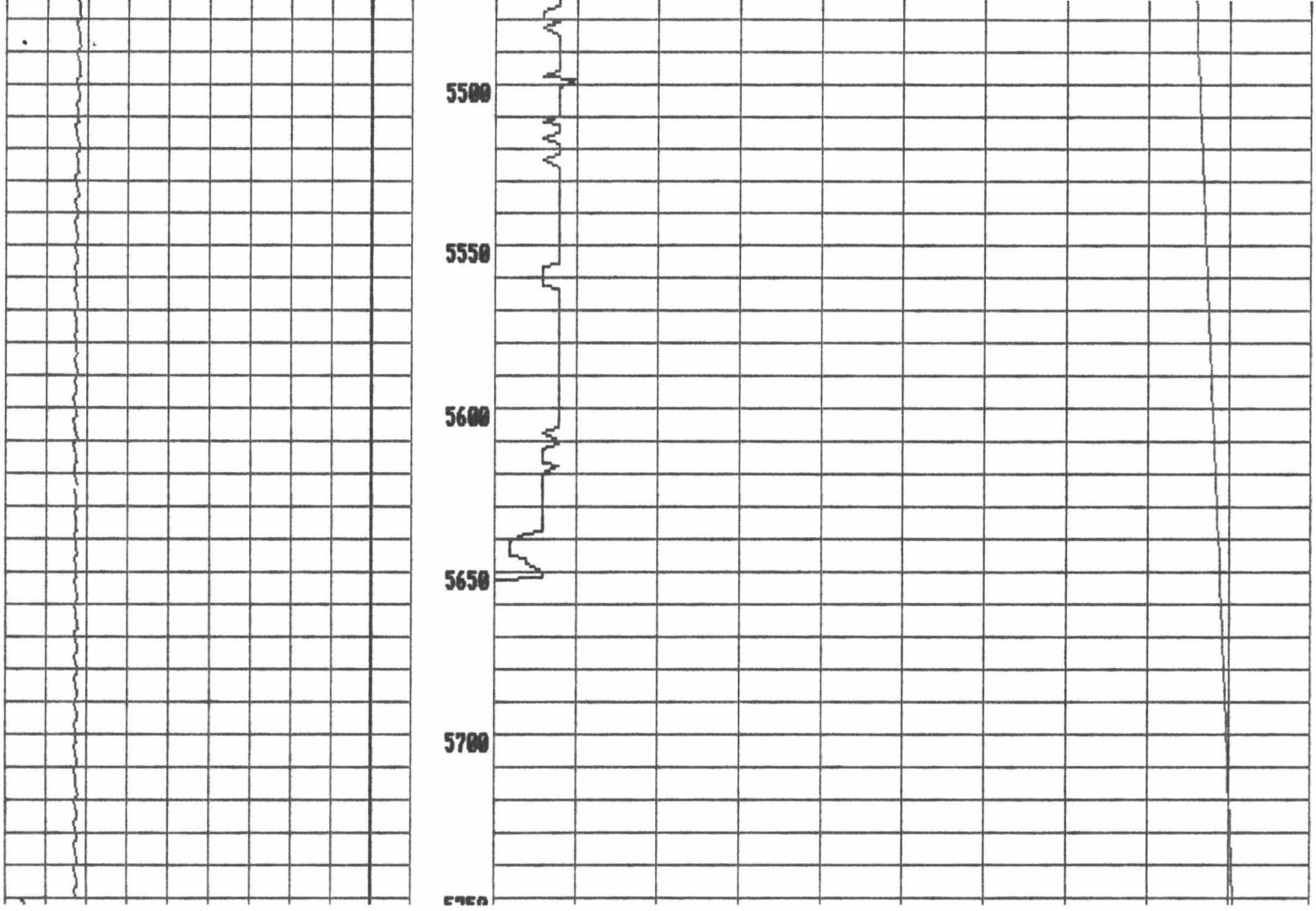
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5700

HOT HOLE INSTRUMENTS INC.

Production Logs

COMPANY: True Geothermal Energy Co.
WELL: KA-1
FIELD: KMERZ
COUNTY: STATE: Hawaii

LOCATION: SEC. TWP. RGE.

PERMANENT DATUM: K.B. 27' ELEV.:
LOG MEASURED FROM: K.B DRILLING MEASURED FROM: K.B.

DATE:	10-29-94
RUN NO.	one
TYPE LOG	P.T.S.
DEPTH - DRILLER	7850'
DEPTH - LOGGER	5756'
BOTTOM LOGGED INTERVAL	5756'
TOP LOGGED INTERVAL	27'
TYPE FLUID IN HOLE	brine
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	953'
MAX. REC. PRESS.	1812 psia
MAX. REC. TEMP. F.	450
OPR. RIG TIME	
RECORDED BY	H.H.I.
WITNESSED BY	G. Niimi

ELEVATIONS

KB. 27'
DF.
GL.

UNIT #
TOOL #
LENGHT: 13.0'
DIA.: 3.0"

OTHER SERVICES:
Sinker Bar
Caliper

RUN	DATA FILE NAME
1	KA1.L1
2	KA1.D5
3	
4	
5	
L/H	

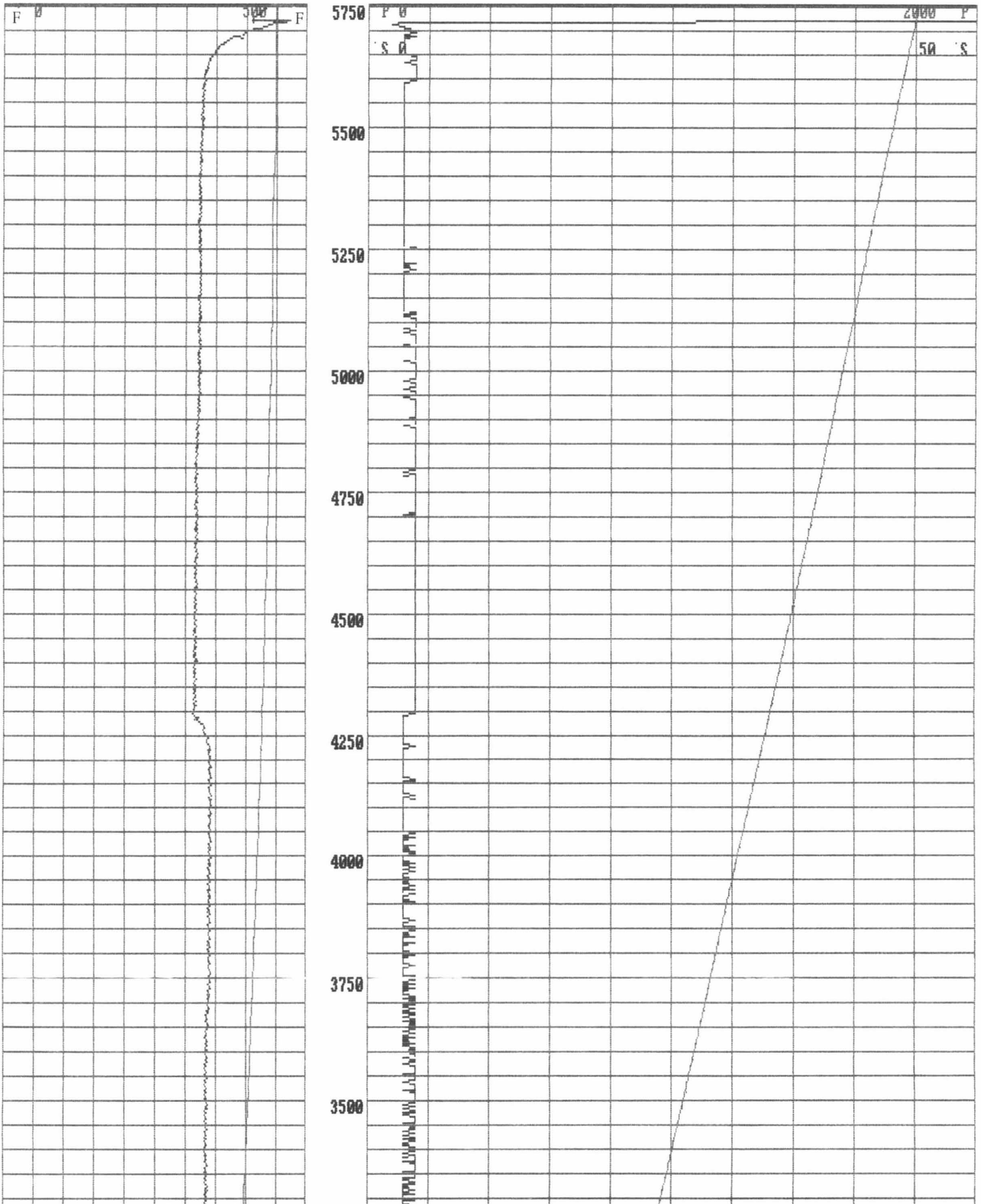
SIZE	WGT.	FROM	TO
13-3/8"		0	3370'
9-5/8"		2485'	5335'
7"		5115'	7850'

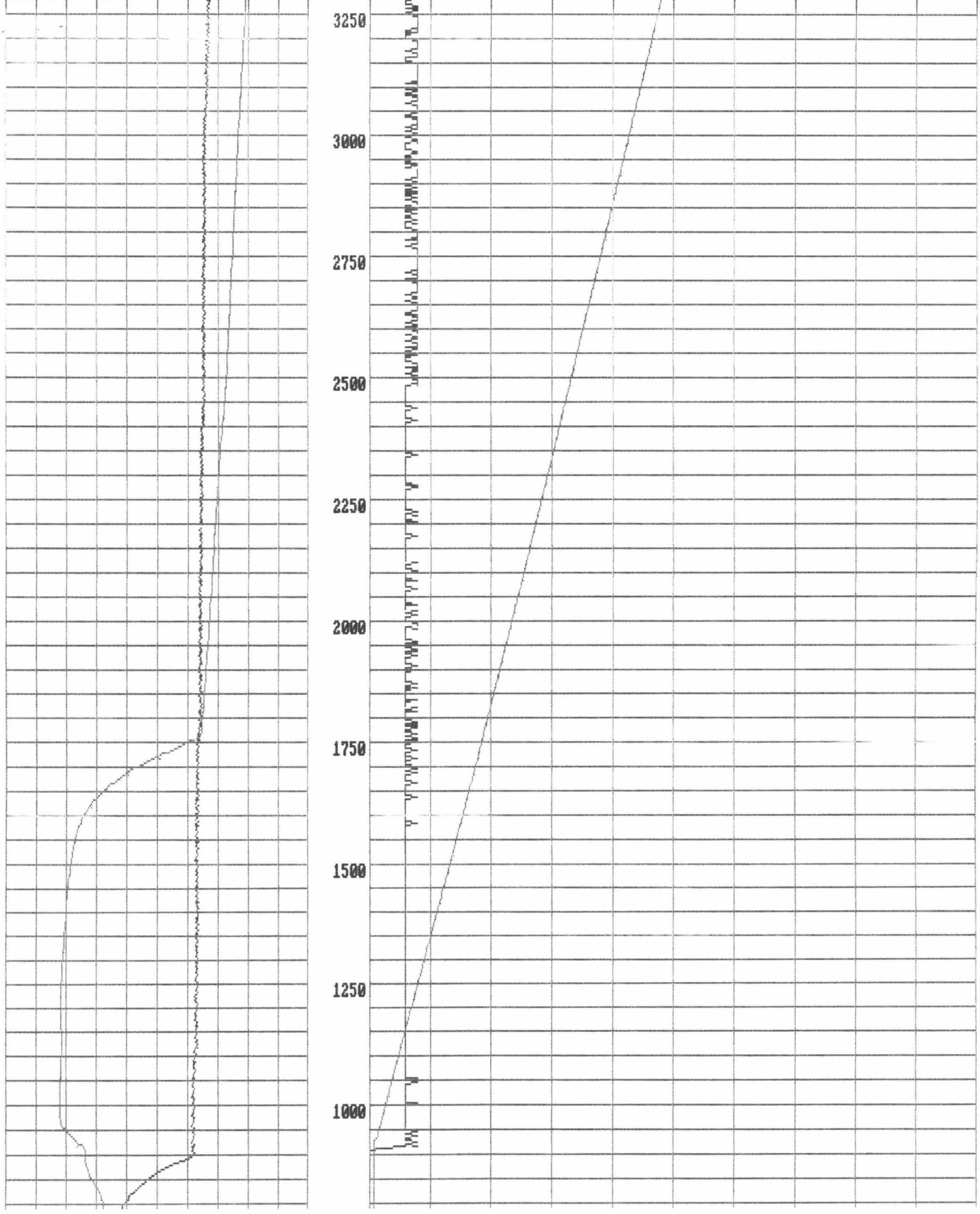
PERFS:	TYPE	FROM	TO
	slots	5115'	7850'

REMARKS:

0°F TEMPERATURE 500°F 0-PSI PRESSURE RANGE 2,000-PSI

300-FPM LOGRATE 0-FPM 0-RPS SPINNER RANGE 50-RPS

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2500
2250
2000
1750
1500
1250
1000

HOT HOLE INSTRUMENTS INC.

Production Logs

COMPANY: True Geothermal Energy Co.
WELL: KA-1
FIELD: KMERZ
COUNTY: STATE: Hawaii

LOCATION: SEC. TWP. RGE.

PERMANENT DATUM: K.B. 27' ELEV.:
LOG MEASURED FROM: K.B DRILLING MEASURED FROM: K.B.

DATE:	10-29-94
RUN NO.	one
TYPE LOG	P.T.S.
DEPTH - DRILLER	7850'
DEPTH - LOGGER	5756'
BOTTOM LOGGED INTERVAL	5756'
TOP LOGGED INTERVAL	27'
TYPE FLUID IN HOLE	brine
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	953'
MAX. REC. PRESS.	1812 psia
MAX. REC. TEMP. F.	450
OPR. RIG TIME	
RECORDED BY	H.H.I.
WITNESSED BY	G. Niimi

ELEVATIONS

KB. 27'
DF.
GL.

UNIT #
TOOL #
LENGHT: 13.0'
DIA.: 3.0"

OTHER SERVICES:
Sinker Bar
Caliper

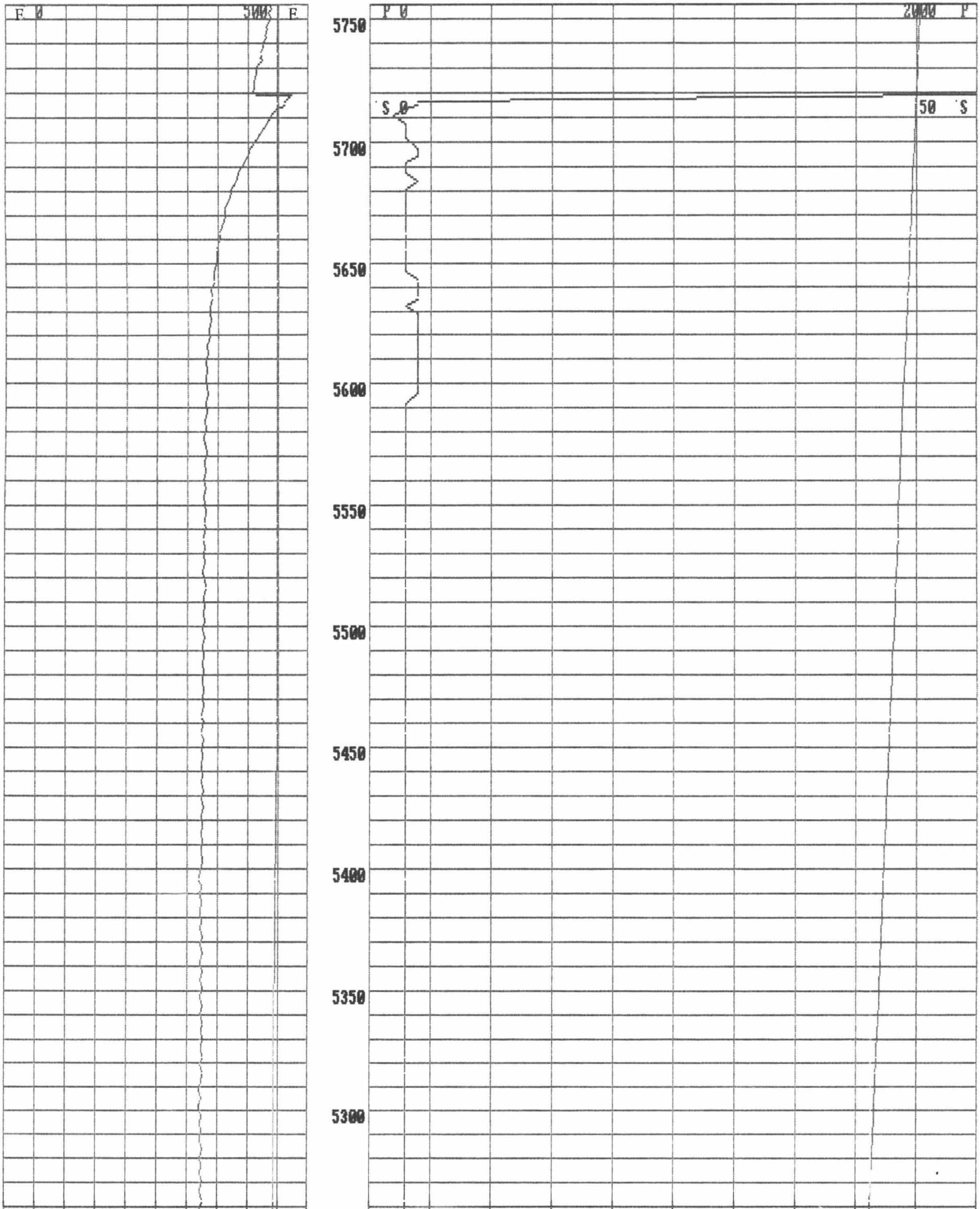
RUN	DATA FILE NAME
1	KA1.L1
2	KA1.D5
3	
4	
5	
L/H	

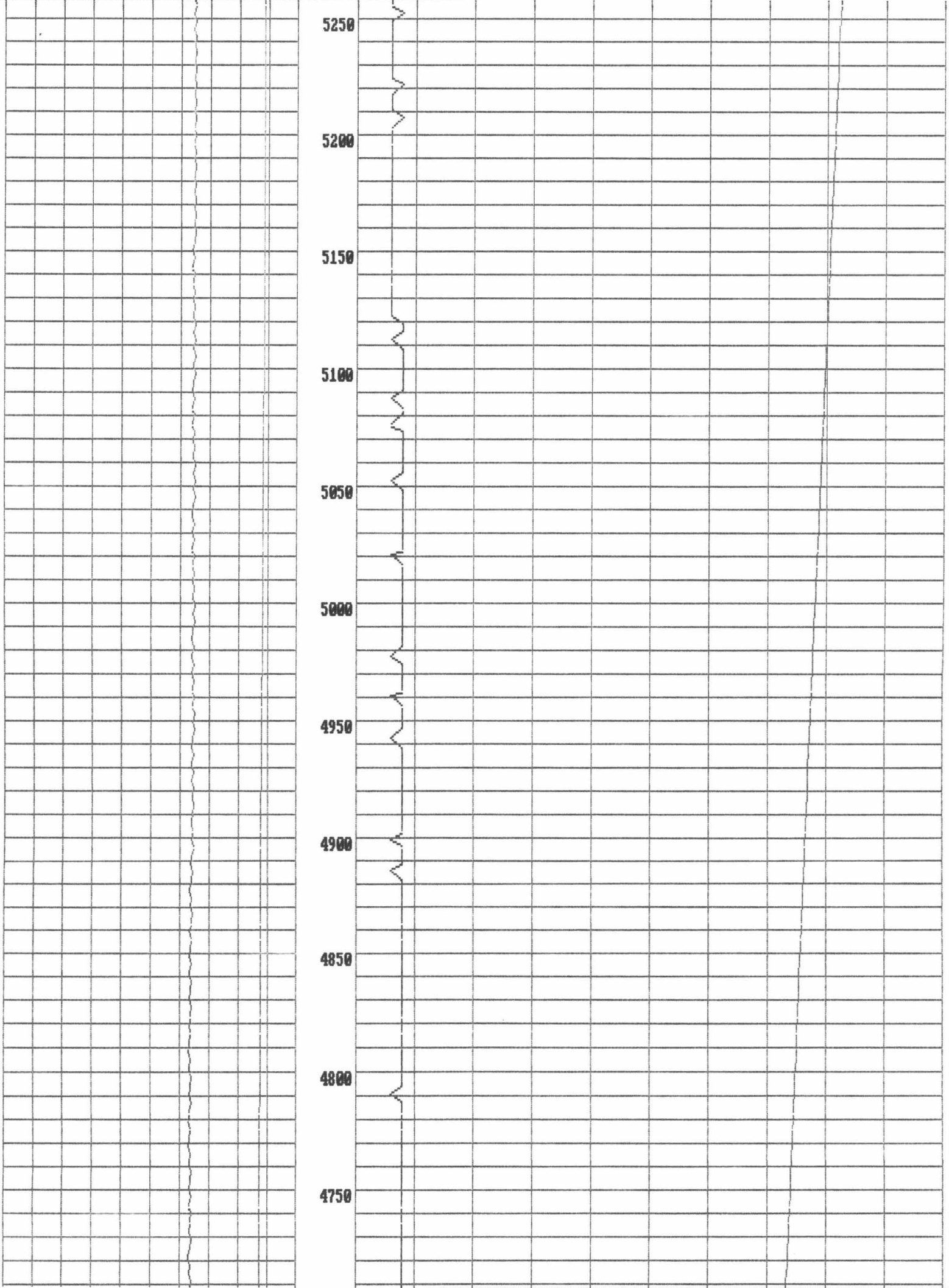
CASING RECORD

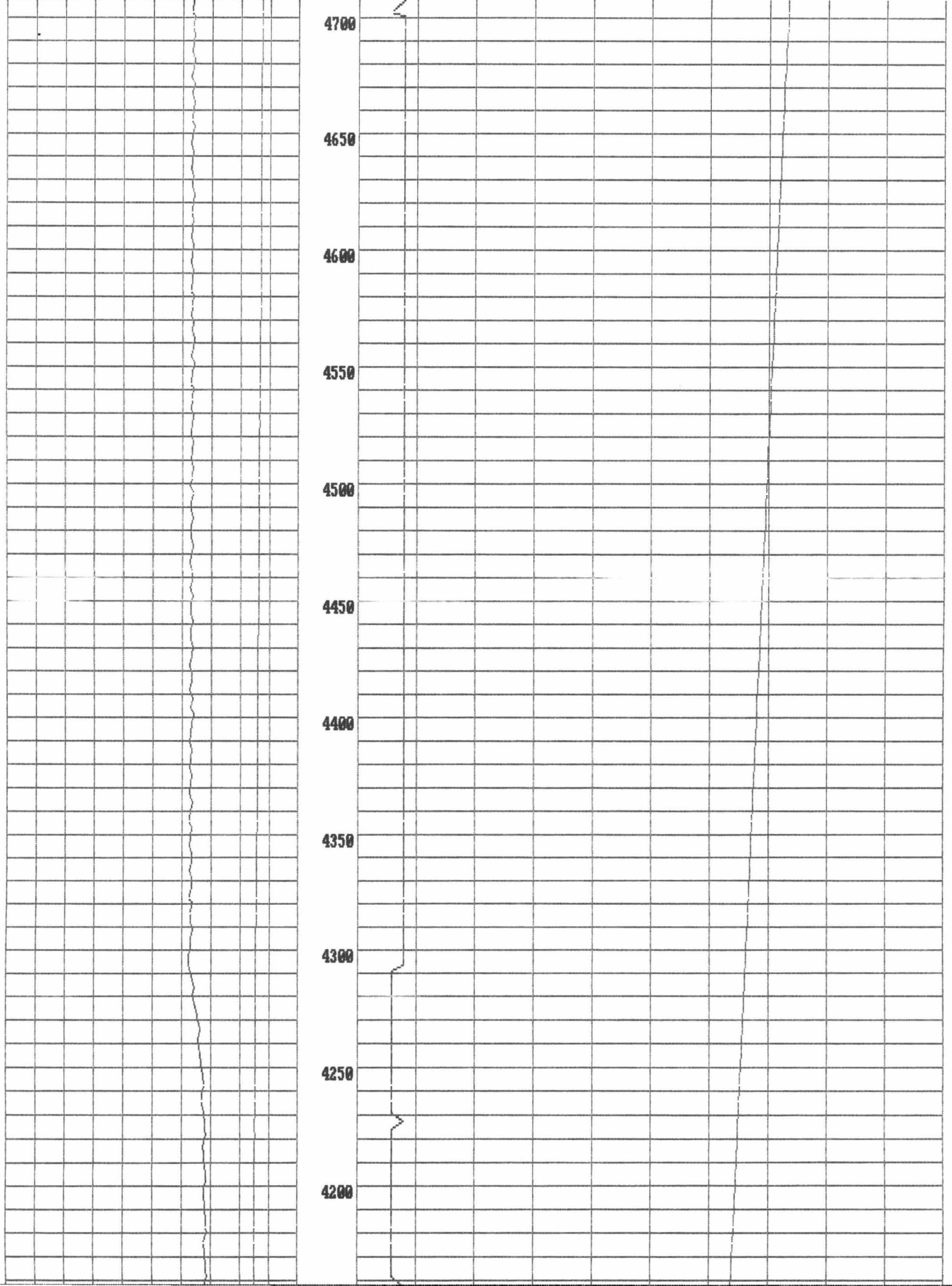
SIZE	WGT.	FROM	TO
13-3/8"		0	3370'
9-5/8"		2485'	5335'
7"		5115'	7850'

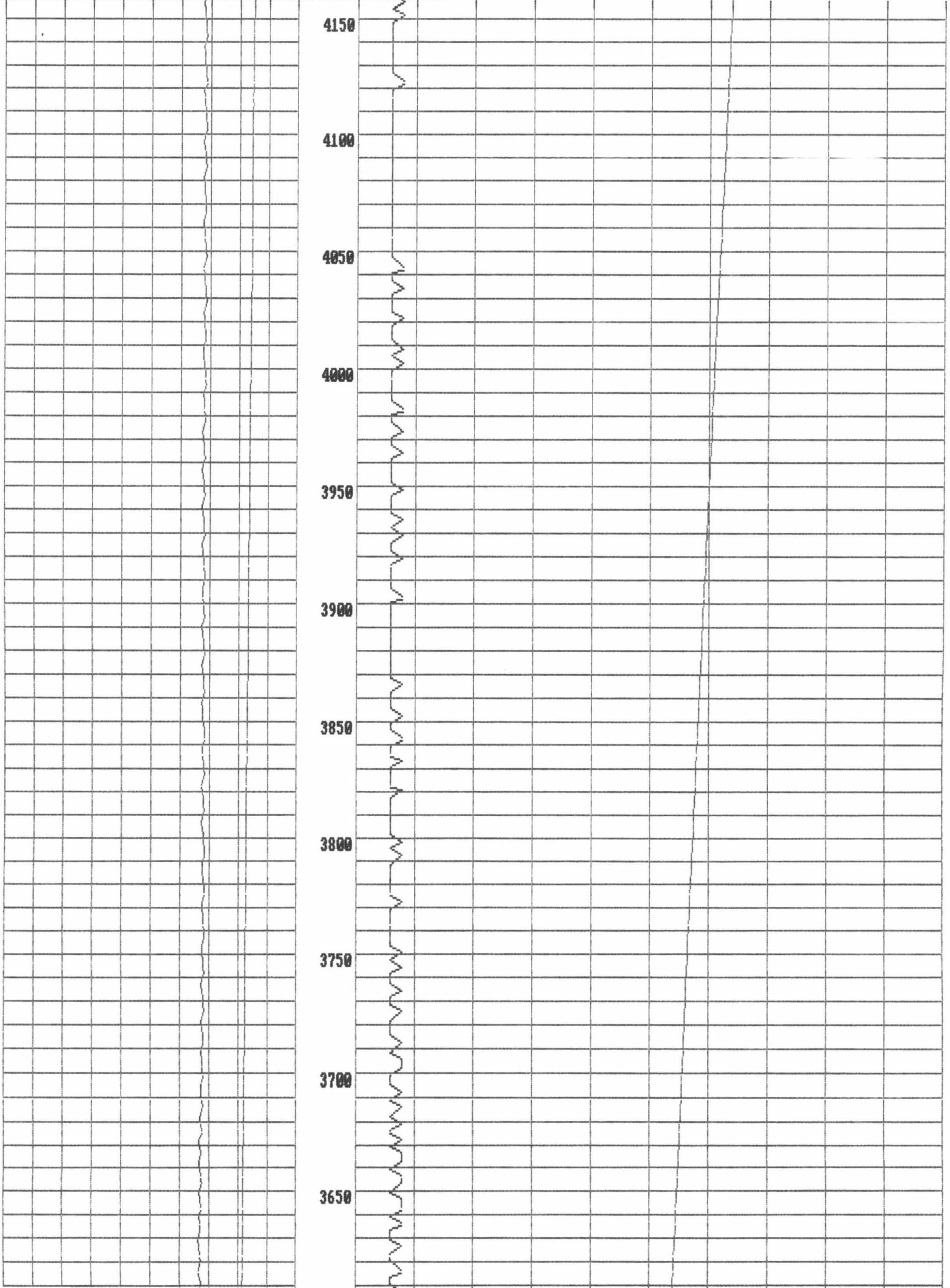
PERFS:	TYPE	FROM	TO
	slots	5115'	7850'

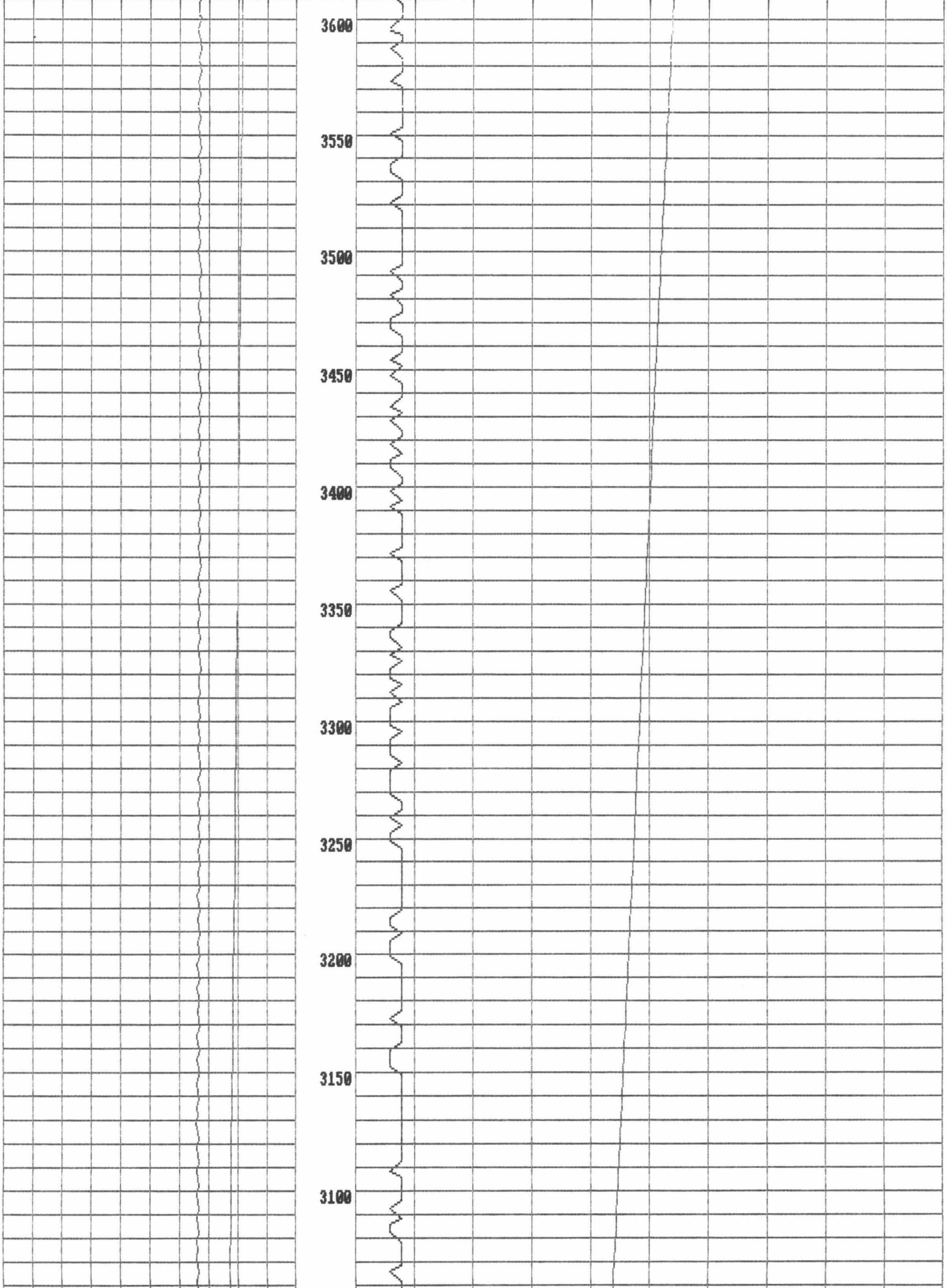
REMARKS:

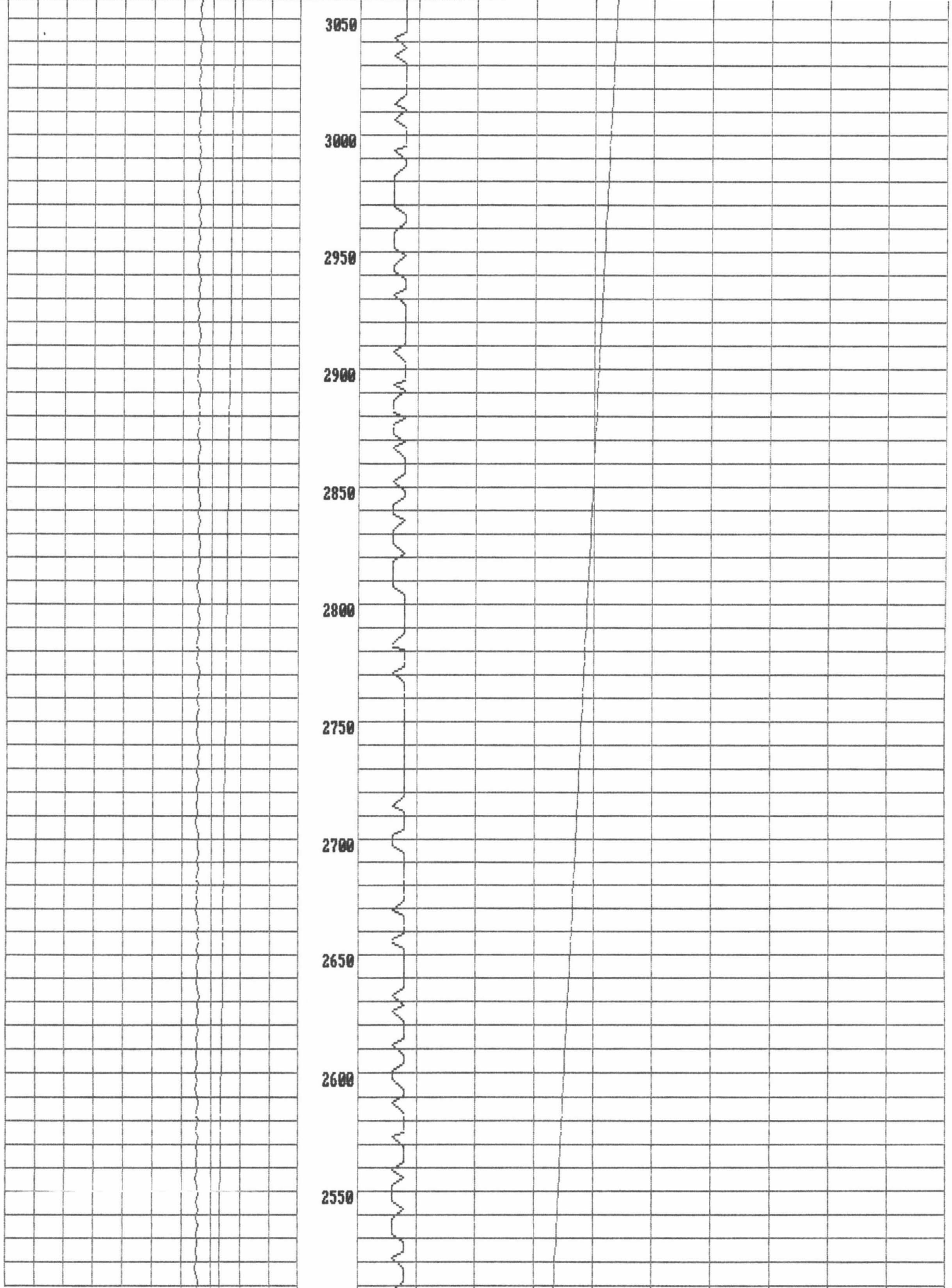

0°F
TEMPERATURE
500°F
0-PSI
PRESSURE RANGE
2,000-PSI
300-FPM
LOGRATE
0-FPM
0-RPS
SPINNER RANGE
50-RPS
F 0
500 F
P 0
2000 P
S 0
50 S
5750
5700
5650
5600
5550
5500
5450
5400
5350
5300

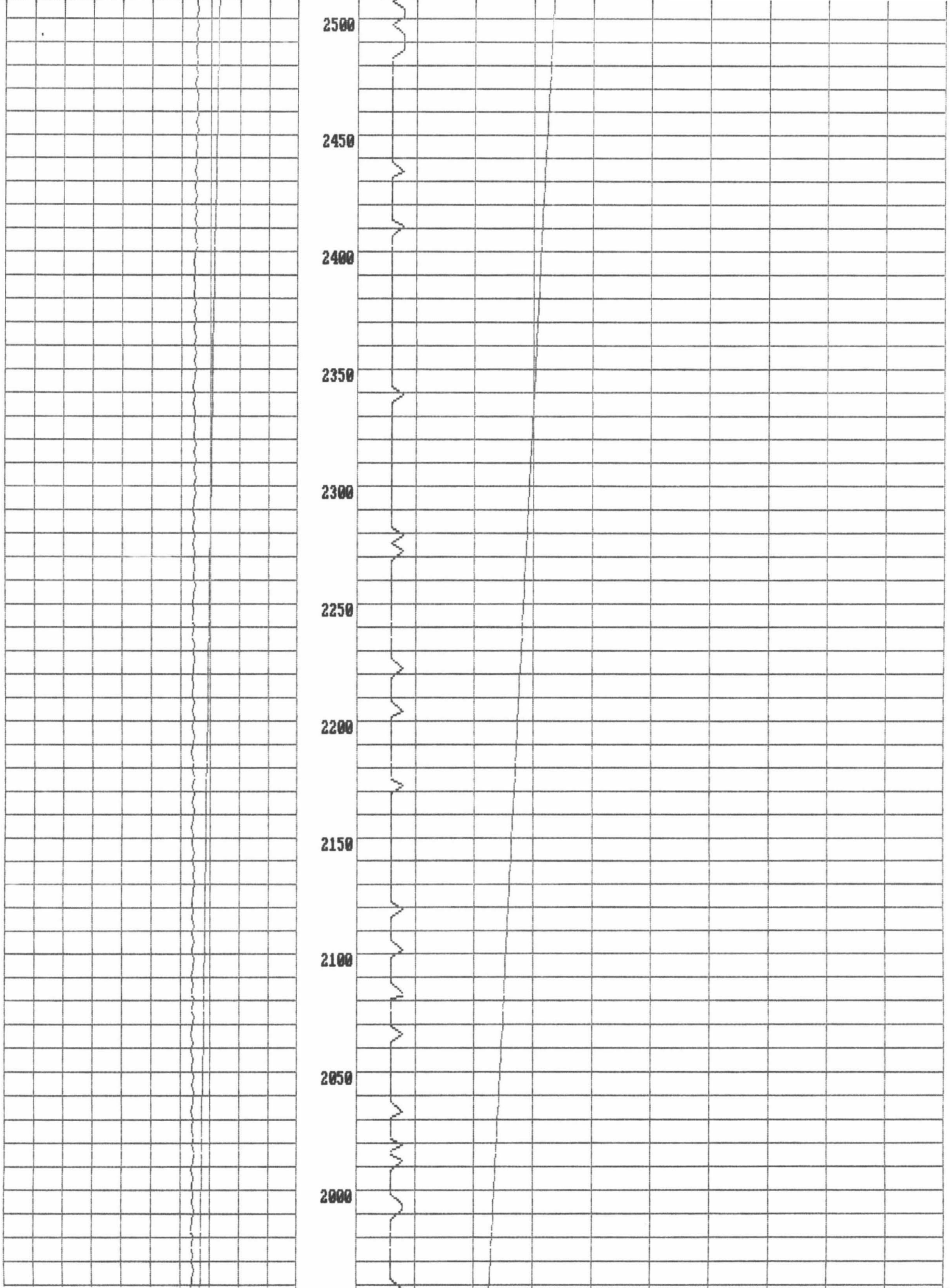

5250
5200
5150
5100
5050
5000
4950
4900
4850
4800
4750

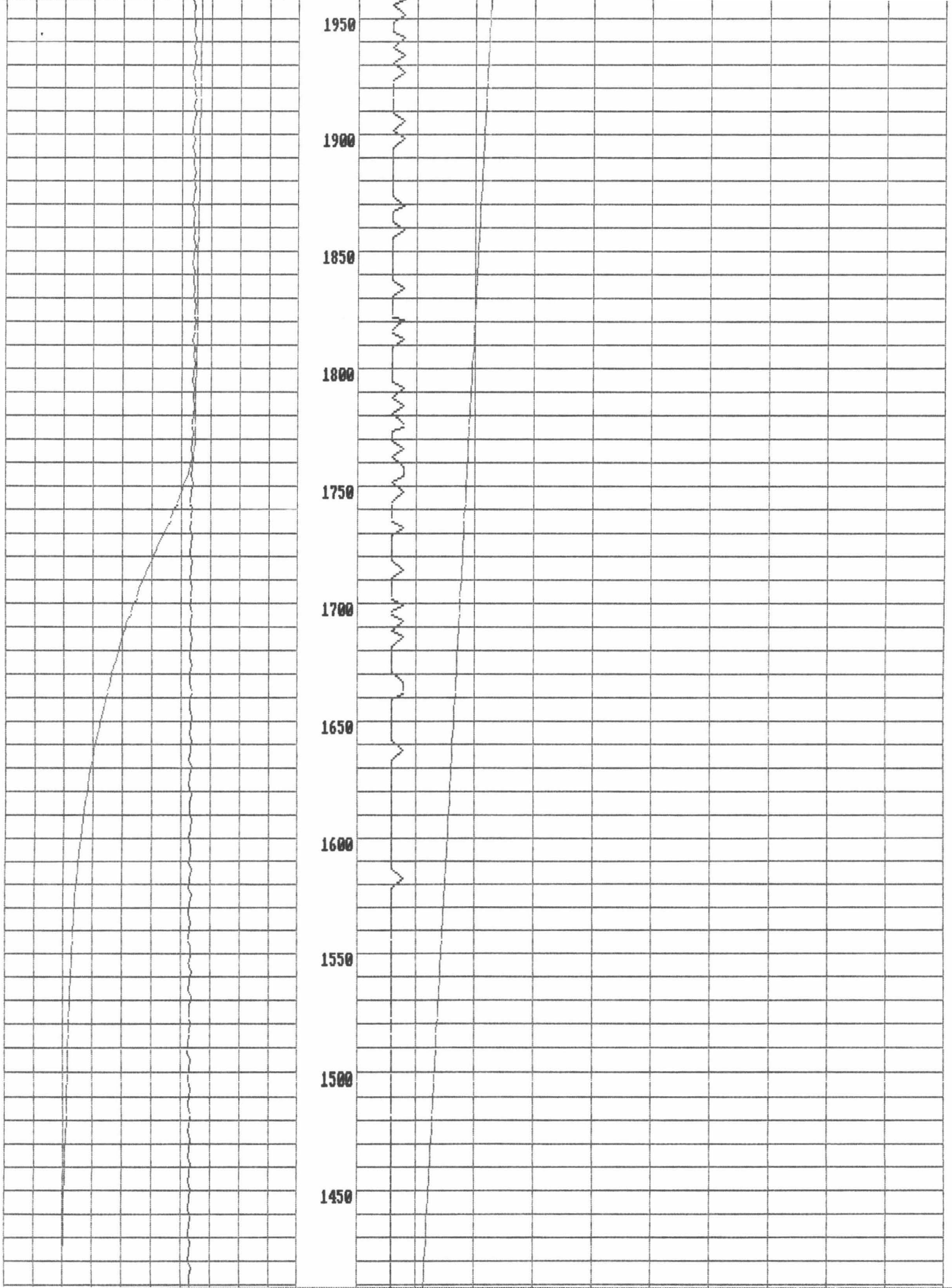

4700
4650
4600
4550
4500
4450
4400
4350
4300
4250
4200

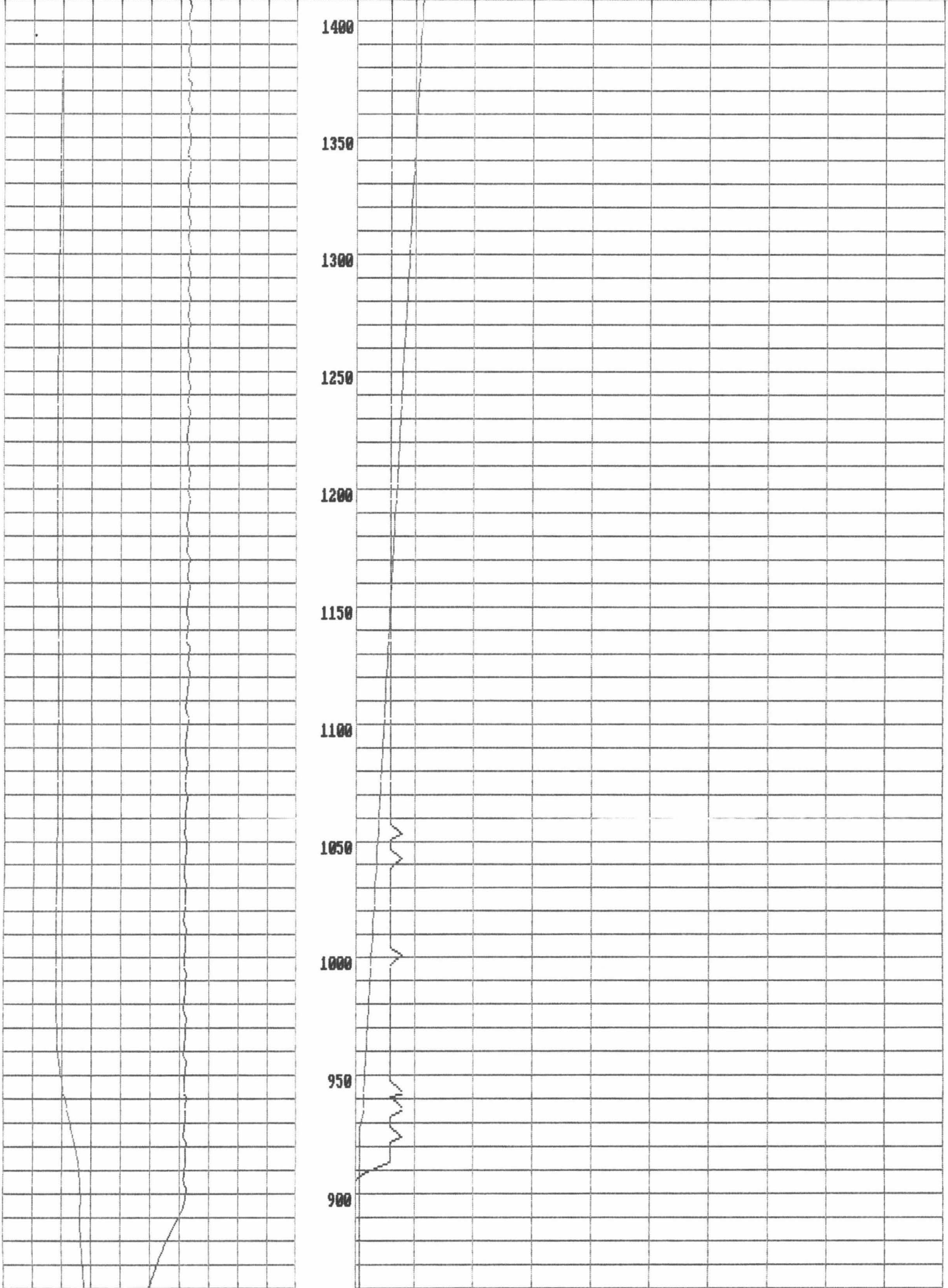

4150
4100
4050
4000
3950
3900
3850
3800
3750
3700
3650

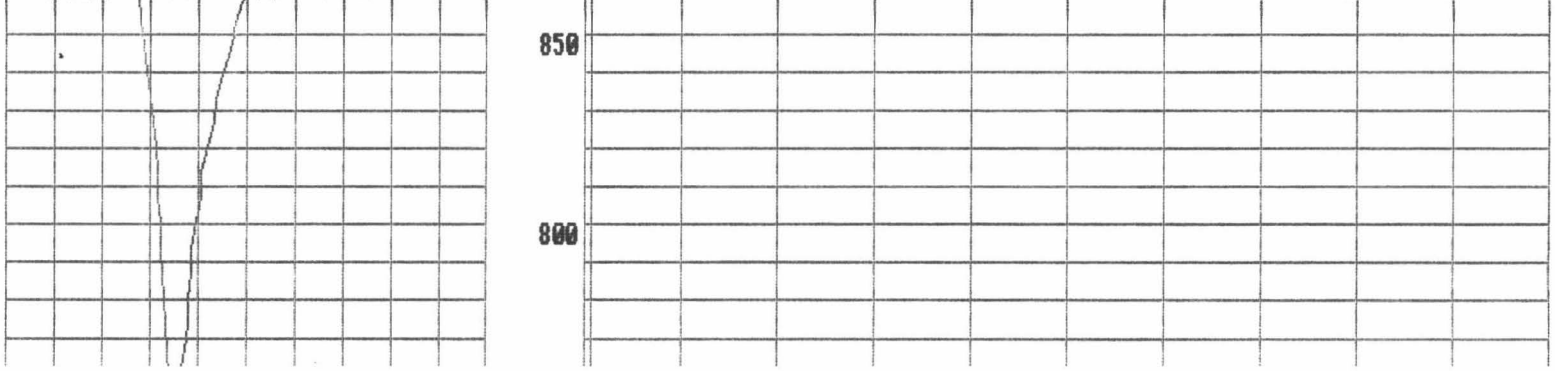

3600
3550
3500
3450
3400
3350
3300
3250
3200
3150
3100


3050
3000
2950
2900
2850
2800
2750
2700
2650
2600
2550


2500
2450
2400
2350
2300
2250
2200
2150
2100
2050
2000


1950
1900
1850
1800
1750
1700
1650
1600
1550
1500
1450


1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900


850
800

HOT HOLE INSTRUMENTS INC.

Production Logs

COMPANY: True Geothermal Energy Co.
WELL: KA-1
FIELD: KMERZ
COUNTY: STATE: Hawaii

LOCATION: SEC. TWP. RGE.

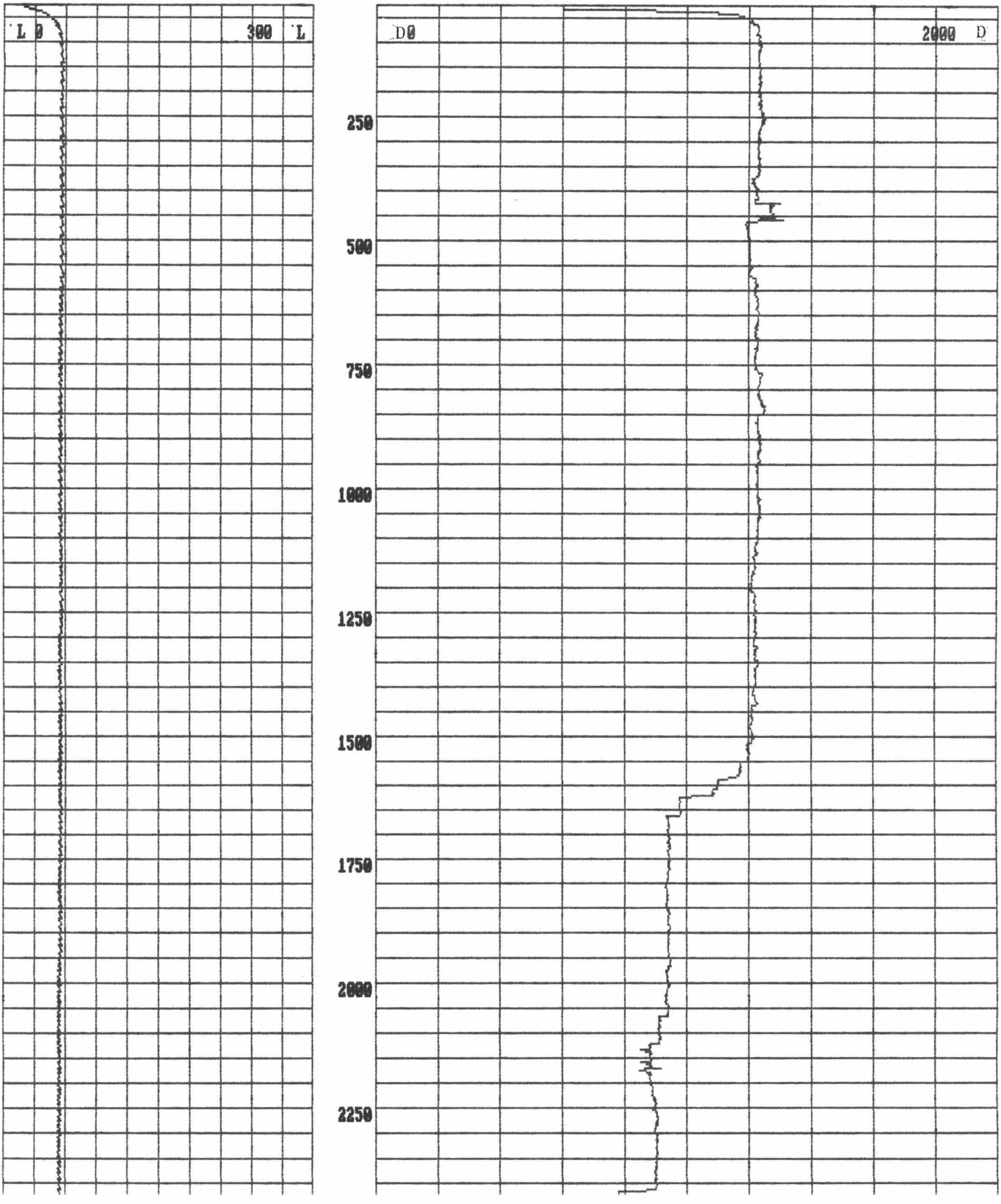
PERMANENT DATUM: K.B. 27' ELEV.:
LOG MEASURED FROM: K.B DRILLING MEASURED FROM: K.B.

DATE:	10-30-94		ELEVATIONS
RUN NO.	two		
TYPE LOG	Caliper		KB. 27'
DEPTH - DRILLER	7850'		DF.
DEPTH - LOGGER	2458'		GL.
BOTTOM LOGGED INTERVAL	2458'		
TOP LOGGED INTERVAL	27'		
TYPE FLUID IN HOLE	brine		UNIT #
SALINITY PPM CL.			TOOL #
DENSITY LB./GAL.			LENGHT:
LEVEL	953'		DIA.:
MAX. REC. PRESS.			
MAX. REC. TEMP. F.			OTHER SERVICES:
OPR. RIG TIME			
RECORDED BY	H.H.I.		
WITNESSED BY	G. Niimi		

RUN	DATA FILE NAME	CASING RECORD			
		SIZE	WGT.	FROM	TO
1	KA1.CLC	13-3/8"		0	3370'
2		9-5/8"		2485'	5335'
3		7"		5115'	7850'
4					
5					
		PERFS:	TYPE	FROM	TO
			slots	5115'	7850'
L/H					

REMARKS:

0-FPM LOGRATE 300-FPM 0-INCHES DIAMETER 20.00 INCHES



HOT HOLE INSTRUMENTS INC.

Production Logs

COMPANY: True Geothermal Energy Co.
WELL: KA-1
FIELD: KMERZ
COUNTY: STATE: Hawaii

LOCATION: SEC. TWP. RGE.

PERMANENT DATUM: K.B. 27' ELEV.:
LOG MEASURED FROM: K.B DRILLING MEASURED FROM: K.B.

DATE:	10-30-94
RUN NO.	two
TYPE LOG	Caliper
DEPTH - DRILLER	7850'
DEPTH - LOGGER	2458'
BOTTOM LOGGED INTERVAL	2458'
TOP LOGGED INTERVAL	27'
TYPE FLUID IN HOLE	brine
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	953'
MAX. REC. PRESS.	
MAX. REC. TEMP. F.	
OPR. RIG TIME	
RECORDED BY	H.H.I.
WITNESSED BY	G. Niimi

ELEVATIONS

KB. 27'
DF.
GL.

UNIT #
TOOL #
LENGHT:
DIA.:

OTHER SERVICES:

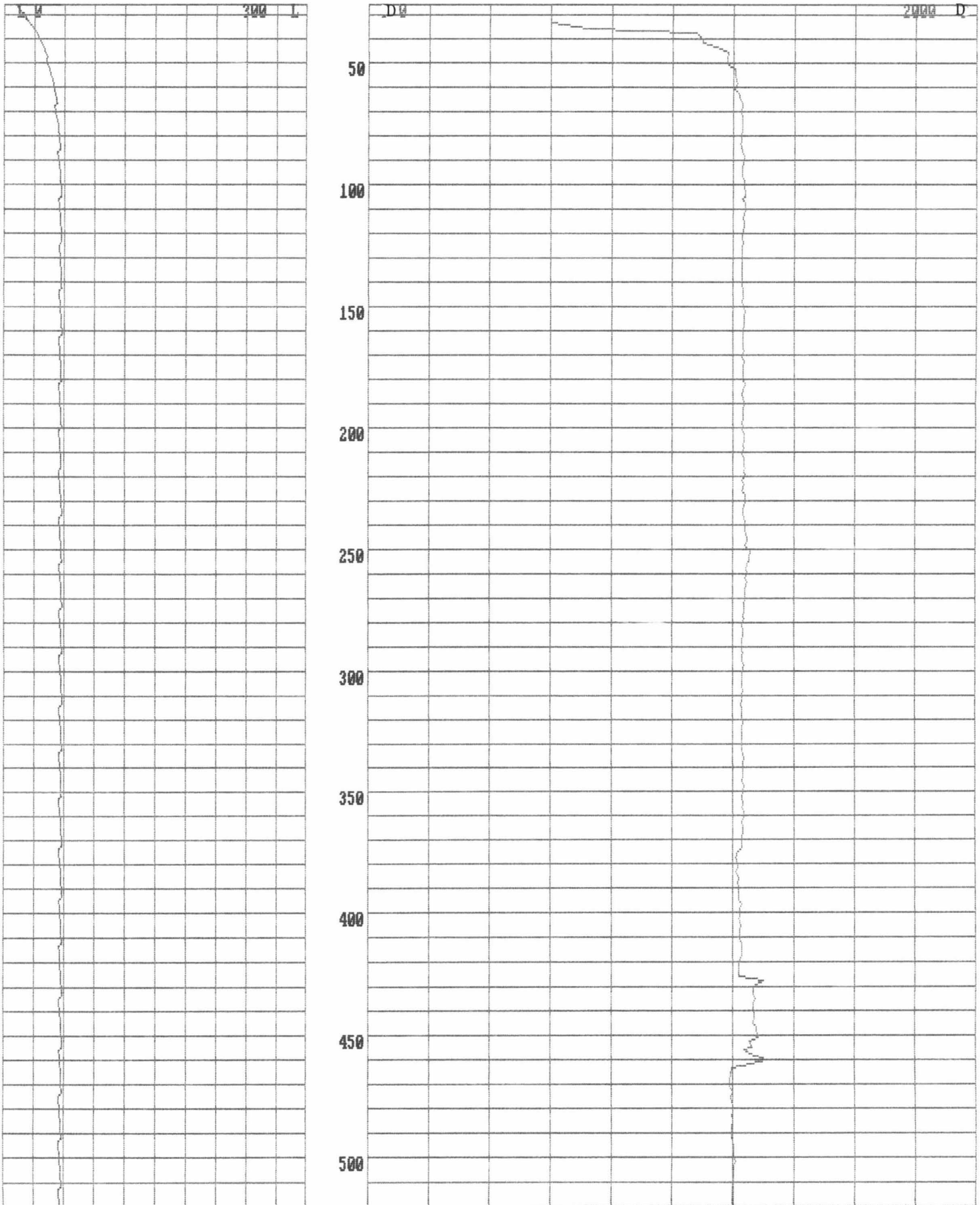
RUN	DATA FILE NAME
1	KA1.CLC
2	
3	
4	
5	
L/H	

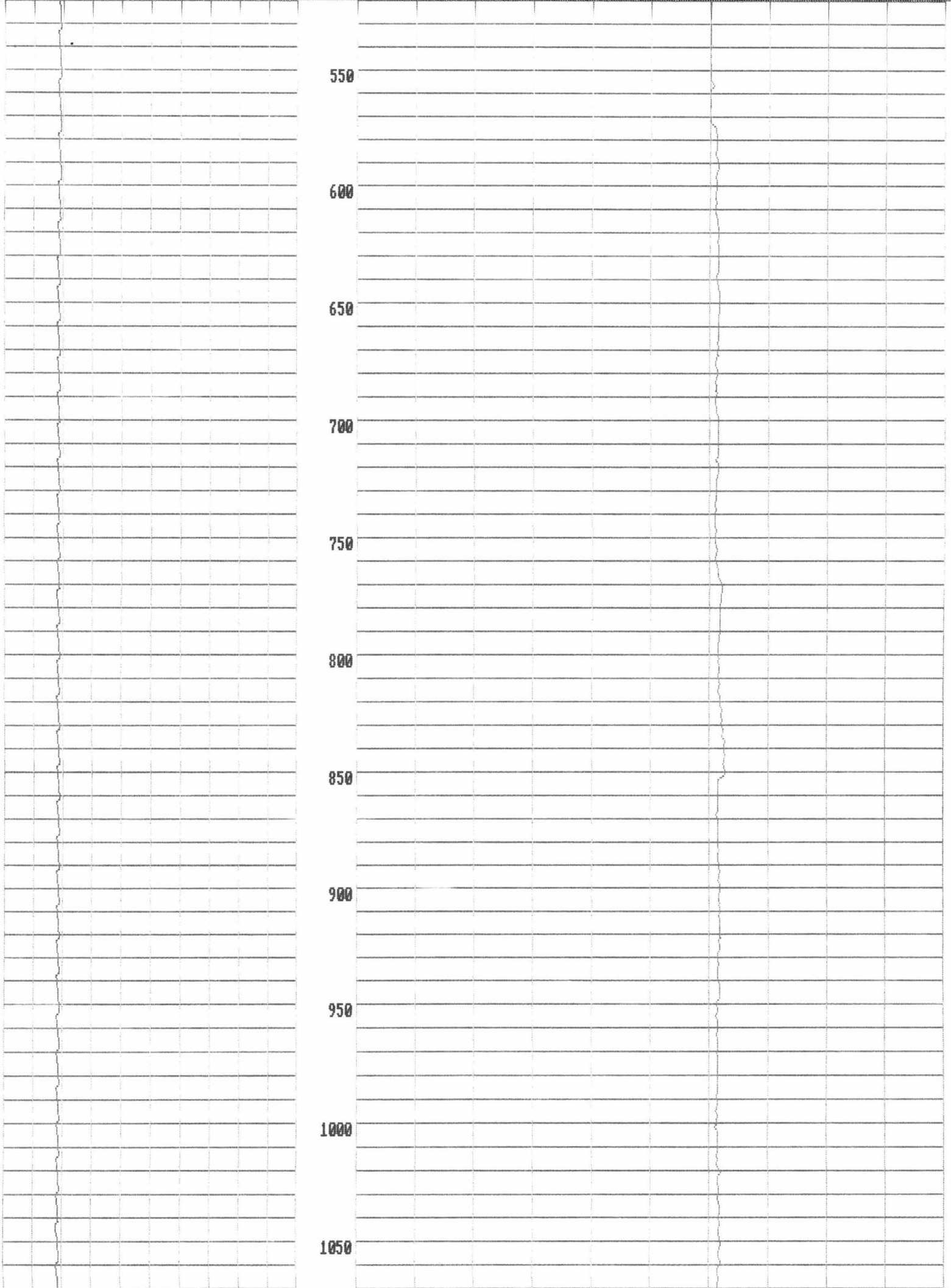
CASING RECORD

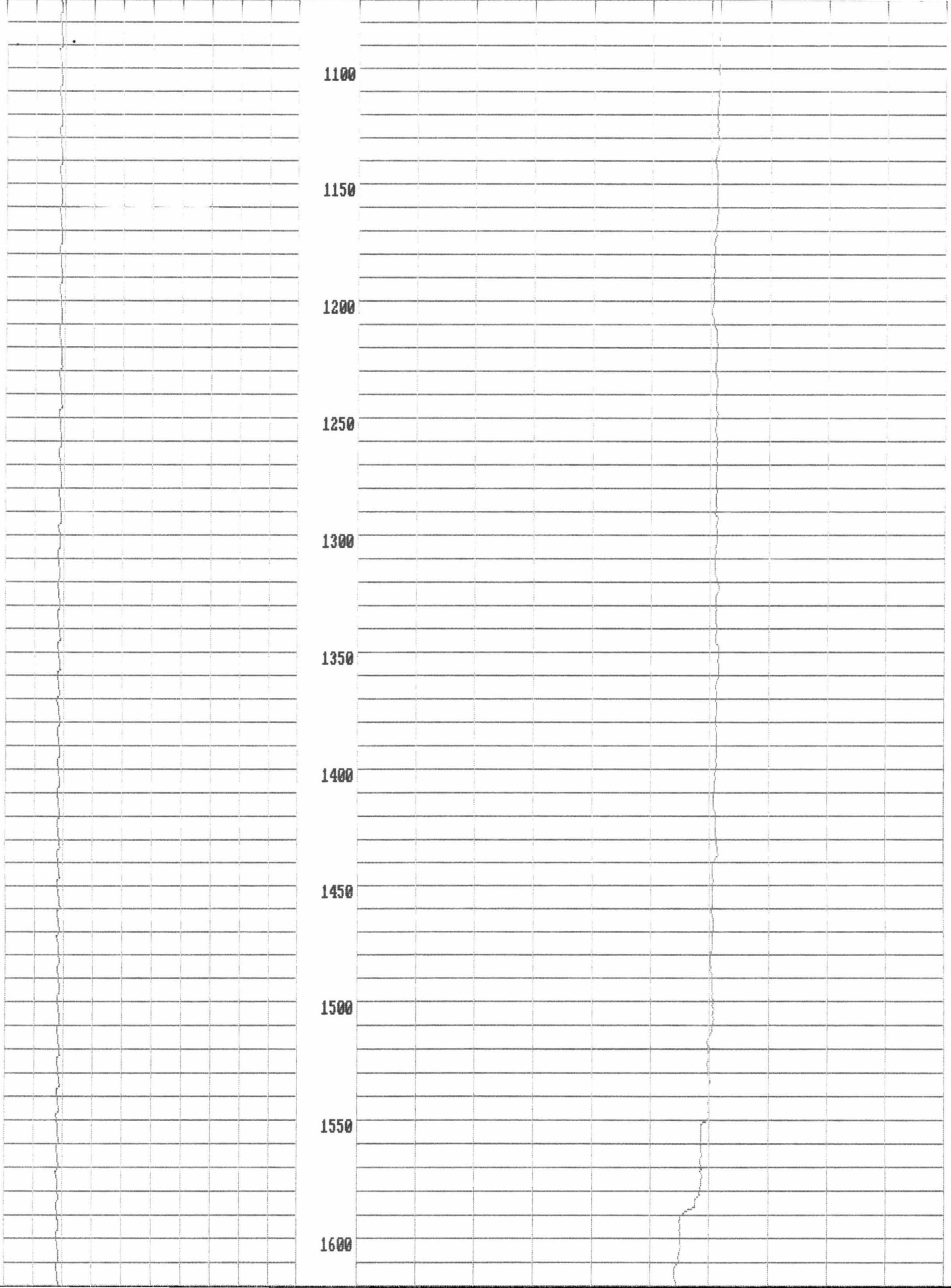
SIZE	WGT.	FROM	TO
13-3/8"		0	3370'
9-5/8"		2485'	5335'
7"		5115'	7850'

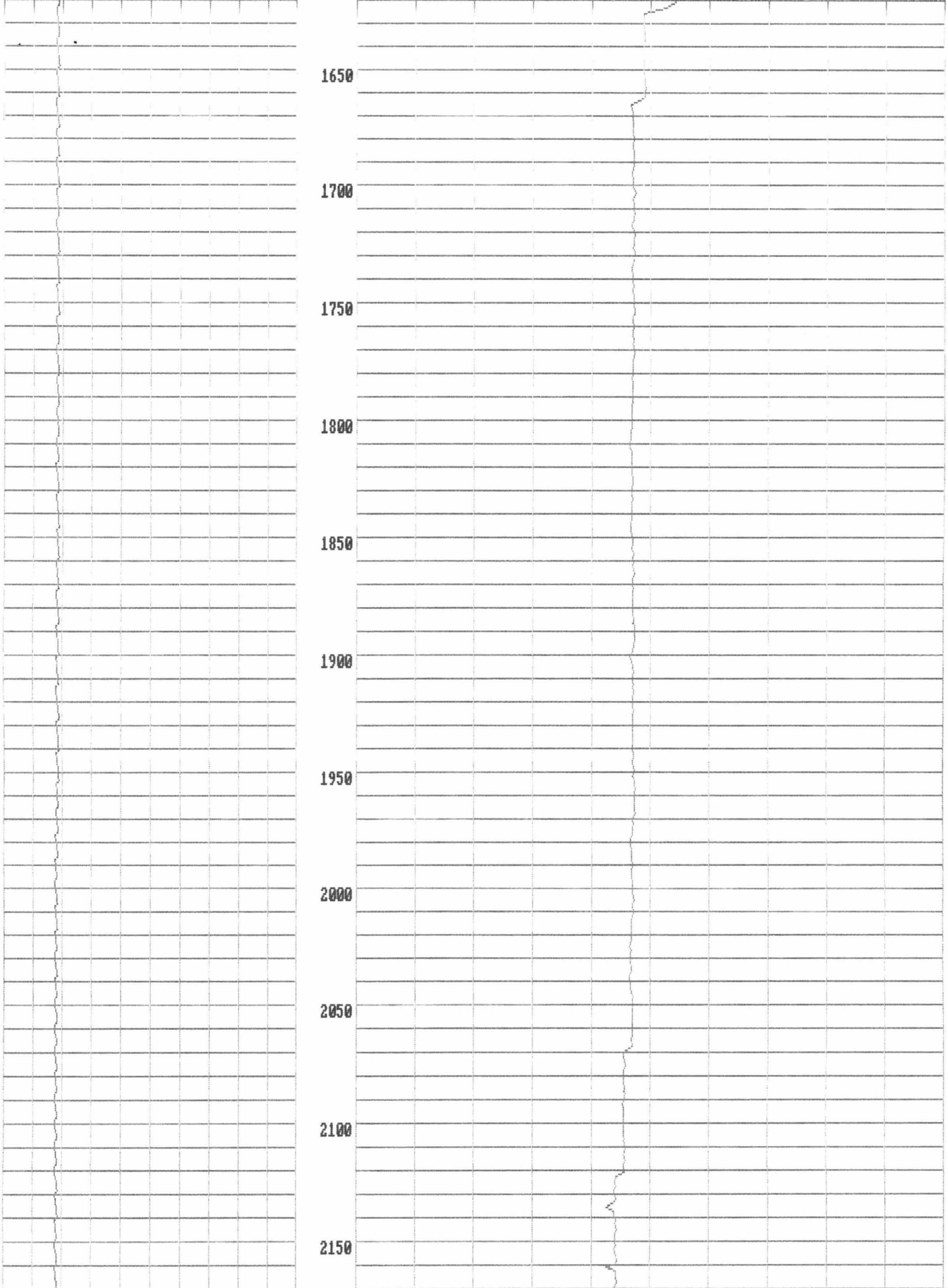
PERFS:	TYPE	FROM	TO
	slots	5115'	7850'

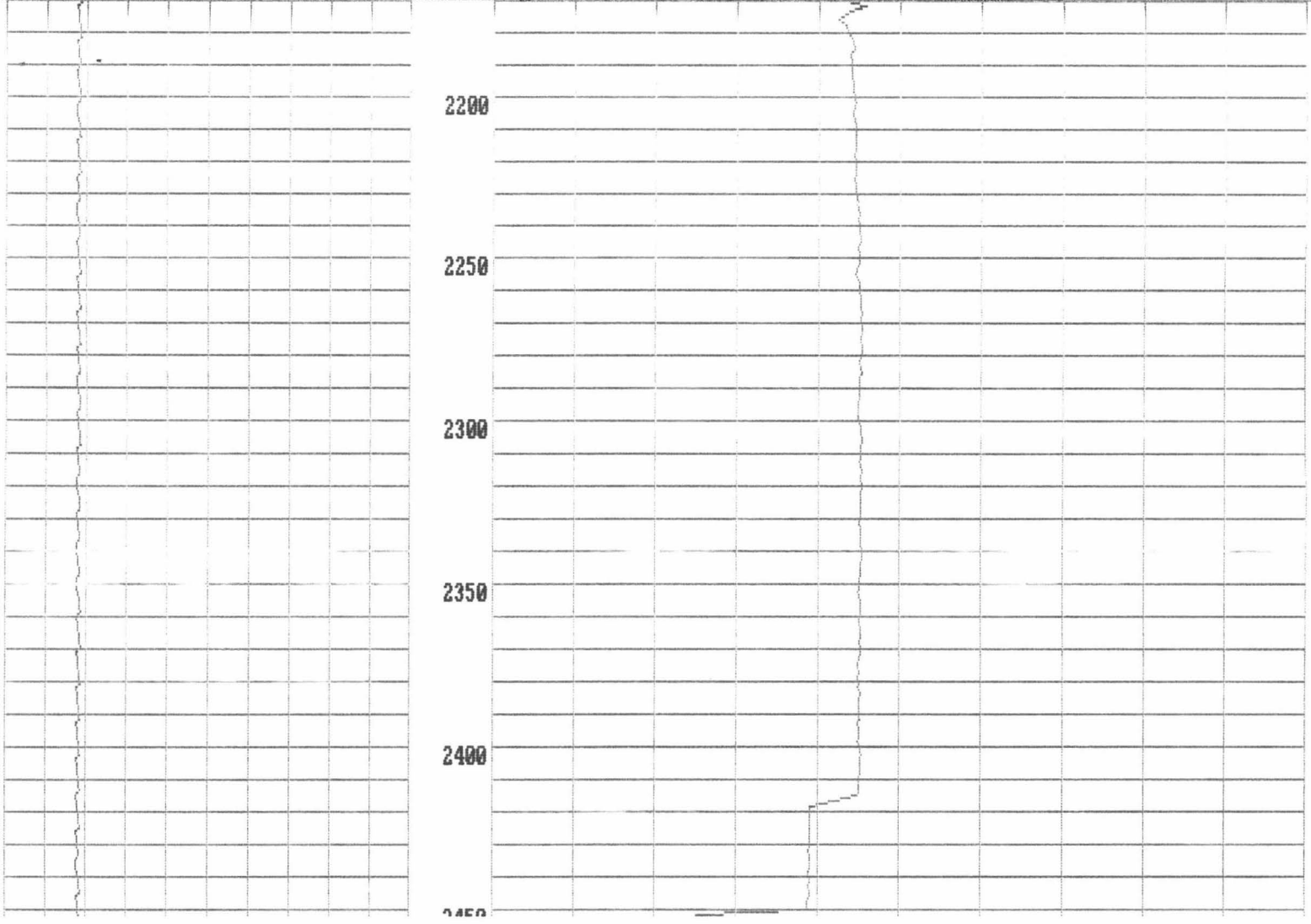
REMARKS:


0-FPM
LOGRATE
300-FPM
0-INCHES
DIAMETER
20.00 INCHES
L 0
300 L
D 0
2000 D
50
100
150
200
250
300
350
400
450
500


550
600
650
700
750
800
850
900
950
1000
1050


1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600


1650
1700
1750
1800
1850
1900
1950
2000
2050
2100
2150


2200
2250
2300
2350
2400